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GENTLEMEN EMINENT IN SCIENCE AND LITERATURE.

THE

FIRST AMERICAN EDITION,

Corrected and improved by the addition of numerous articles relative to

THE INSTITUTIONS OF THE AMERICAN CONTINENT,

ITS GEOGRAPHY, BIOGRAPHY, CIVIL AND NATIONAL HISTORY, AND TO VARIOUS DISCOVERIES IN

SCIENCE AND THE ARTS.

IN EIGHTEEN VOLUMES.

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THE AMERICAN EDITION

OF THE NEW

EDINBURGH ENCYCLOPÆDIA.

BUENOS AYRES.

BUENOS AYRES, the capital of the viceroyalty of Buenos Ayres, extends along the south side of the great river La Plata; and derives its name from the particular salubrity of its climate. It was originally founded by Don Pedro de Mendoza, in 1535, and called *Nuestra Senora de Buenos Ayres*; but the colonists were so reduced by famine, and harassed by the continual hostilities of the neighbouring Indians, that in about four years after, the situation was abandoned as untenable. In the year 1580, however, the colony was re-established under the name of *Santa Trinidada de Buenos Ayres*; and in 1620 was erected into a bishopric, and constituted the capital of a province of the same name. But it was not until it became the seat of the viceregal government, that it could vie in opulence and population with the principal cities of the southern continent. This city is built with great regularity and neatness, and is watered by several small streams which discharge themselves into the La Plata. The principal streets display both taste and opulence. They are broad and straight, with foot-paths on each side; but from the great scarcity of stone, unpaved in the middle, which renders walking very inconvenient during drought, from the quantity of dust which is collected and continually flying about. The houses are generally built of bricks or chalk, with flat roofs, but seldom exceed one story. Many of them have parapet walls on the top, from three to four feet high; and those of the more wealthy inhabitants have a vestibule, and a court surrounded by the apartments. The interior of these houses, however, correspond very ill with their external appearance. During summer, the rooms are covered with India netting, and in winter with European carpets; but from the indolence of the inhabitants, they are seldom kept clean; and that part of the town which is principally inhabited by mestizos and negroes, is nothing but a receptacle of filth. Almost every house is surrounded with a garden; and many have balconies, with lattice-work for containing shrubs and flowers. The principal square, or parade, which is very spacious, faces the La Plata, and is surrounded with superb buildings. On one side, fronting the river, is the castle or fort, which, considered as a post of military importance, is very insignificant; forty cannon of various calibres, and 700 men, are its only defence. It contains the palace of the viceroy, and a royal chapel. On the opposite side is the town-hall, and on the west side stands the cathedral, which is a new and spacious structure, with a cupola and portico of very elegant workmanship; but the interior of the building is rather too profusely decorated with carved and gilt-work. The churches of St Francis, and of the convent of Mercy, are built with a cupola and steeples nearly in the same stile as the cathedral. In the former is a beautiful painting of the Last Supper, by an Indian neophyte. The frame is composed entirely of feathers of a bright gold colour, so contrived as to imitate the most correct carving and gilding, and the difference cannot be discovered by the nicest observer till it is touched with the hand. The church of St John, which stands on the skirts of the town, is appropriated entirely to the use of the Christian Indians. The other public buildings are two hospitals, one for men and the other for women, an orphan hospital, a foundling hospital, and a college where they teach grammar, philosophy, and theology. These edifices are built of a beautiful white stone, which is found not far from the town, and which gives them a light and elegant appearance. The chapter of the cathedral consists of a bishop, whose annual revenue is from 18,000 to 20,000 piastres, three dignitaries, and two canons. Besides these, there are in the city of Buenos Ayres above 136 ecclesiastics, independent of four numerous monasteries of Franciscans, Dominicans, and of the fathers of Mercy and of Bethleem, and two convents of nuns.

The environs of the city for about three leagues, present a beautiful and well cultivated country, full of gardens and groves, and diversified with fields of wheat and maize. Here almost every person in easy circumstances

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has his country house, called *quinta*, a large garden which supplies him with many necessaries of life, and a variety of fruits and plants : all their wine, however, is brought either from Spain or Mendoza. Beyond these fields are immense tracts of meadow, covered with continual verdure, and filled with innumerable flocks of wild horses and oxen, which renders provisions here very cheap. According to Estalla, a thousand head of cattle are daily slain in the neighbourhood for the use of the city, which are brought in carts to the market, where they are examined by a sworn proveditor ; and Helms tells us, that the largest ox is often sold for a piastre, or 4s. 6d. and a good horse for two piastres.

The greatest inconveniences under which the inhabitants of Buenos Ayres labour, are the difficult and dangerous navigation of the La Plata, and the want of a safe and commodious harbour. On account of the numerous islets, shoals, and rocks, with which this river abounds, and the frequency of the *pamperos*, which render a storm here more dreadful than upon the ocean, vessels making for this city must come to anchor every night ; and in the most moderate weather, it is necessary to send a pilot to sound the way for the ship. But the danger does not even end with the voyage ; for there is no part on the coast where vessels of any burden can enter nearer than the bay of Barragan, which is about seven leagues distance ; and the anchorage ground opposite to Buenos Ayres is nearly three leagues from the shore. All their goods must consequently be landed in lighters or boats, which enter a small creek at the mouth of the Rio Chuelo, about a quarter of a league from the town, to which they are conveyed in carts ; and the vessels generally fall down to the bay of Barragan to refit and wait for their cargoes. It was to remedy these inconveniences, that the court of Spain ordered a settlement to be established at Monte Video in 1726, where nature has formed one of the finest havens in the world. At this port, the merchandise which is imported from Spain is debarked, and carried in boats to Buenos Ayres, from whence it is disseminated throughout the viceroyalty. For an account of the commerce of this city, see vol. iv. part ii. p. 790.

The number of inhabitants in Buenos Ayres has been estimated very differently by different travellers. Helms makes it from 25,000 to 30,000 : while Sir Home Popham carries it so high as 70,000. Forty thousand is the estimate of Azara, which we suppose to be the most correct. South Lat. 34° 36′ 28″, West Long. 58° 31′ 15″. (*p*)

BUFFALOE. See MAMMALIA.

BUFFON, GEORGE LOUIS LE CLERC, a celebrated naturalist, was born at Montbard in Burgundy, on the 7th of September 1707. His father was Benjamin Leclerc Buffon, counsellor of parliament in Burgundy, and the maiden name of his mother was Mademoiselle de Merlin.

Being destined by his father for the profession of the law, Buffon commenced his studies at the college of Dijon ; but the passion which he began to feel for the mathematical sciences, withdrew his attention from every other subject. The Elements of Euclid, and the works of the Marquis de L'Hospital, were the first books that were put into his hands ; and such was his attachment to the former, that he always carried it in his pocket, and was often observed to retire from his companions at play, and to attempt, in some solitary corner, the resolution of any problem with which he had been perplexed.

The success that attended these youthful exertions was tly brilliant to create new excitements to his genius. At the age of twenty, he is said to have discovered the binomial theorem, without knowing that he had been anticipated by Newton ; and when at a future period of his life he was asked by M. Herault de Sechelle, why he had never published this fact in any of his works, he replied, that "nobody was obliged to believe it." In 1727, Buffon became acquainted at Dijon with the young Lord Kingston, whose tutor had paid particular attention to the sciences. In consequence of this connection, he determined to travel, and after following his friend into England, he accompanied him to Italy. In that delightful country, sacred to literature and the arts, and endeared to every scholar by associations the most interesting, Buffon was enchanted only by the phenomena which nature presented. The works of human skill, though exhibited in their most perfect form, had no charm for a mind passionately devoted to the philosophy of nature. It was in the deep valley, among the rugged precipices, on the summits of the lofty mountains, or among the torrents of lava which had formerly rushed from the bowels of the earth, that Buffon began his sublime speculations on the ancient convulsions and revolutions of the globe.

About this time, in the year 1728, he succeeded to the estate of his mother, which brought him an annual income of about 12,000*l.* and which enabled him to carry on, in affluence and independence, those scientific pursuits to which the rest of his life was devoted. On his return from Italy to France, he repaired to Angers, where he quarrelled with an Englishman ; and having wounded his adversary, he took refuge in Paris. From Paris he went to England, where he remained only three months, and on his return to France, he began that scientific career which he afterwards pursued with so much success and glory.

The first work published by Buffon, was a translation of Hales' *Vegetable Statics*, which appeared in 1735, and which was followed in 1740 by a translation, from the Latin, of *Newton's Fluxions*. The prefaces with which these translations were enriched, were distinguished by that dignity of stile which characterised all the subsequent works of this illustrious naturalist.

With the view of applying the physical sciences to objects of real practical utility, Buffon made a course of experiments on the strength of wood, from which it appeared, that, in order to give a ligneous consistency to the alburnum, it is necessary to strip the bark from the foot of the tree at the time of the sap, and to allow it to dry, and to wither after this operation. The attention of Buffon was likewise turned to the burning mirrors of Archimedes, and he had the honour of being the first among the moderns who constructed an instrument approaching in its efficacy to the supposed invention of the Syracusan geometer. In the year 1748, he proposed a lamp, *à echelons*, which was executed about thirty years afterwards by the Abbé Rochon. See BURNING MACHINE, where a full account of Buffon's Burning Mirror will be found.

In the year 1739, Buffon succeeded M. Dufai as Intendant of the Royal Garden and Cabinet, an event which fixed the resolution which he had formerly made of devoting himself wholly to the study of natural history. He now began to collect materials for his great work, and in 1744, he published a part of it under the title of *A Theory of the Earth*, which he afterwards included in his larger work. The first volume of his *Natural History* appeared in 1749, and the book was completed in 1767, in fifteen volumes 4to, or 31 vols. 12mo.

The freedom of his religious sentiments, which appears in all his works, provoked the indignation of the Sorbonne, but he had the good sense to dissipate the fears, and to disarm the hostility of the learned doctors, by an explanation with which they were completely satisfied. To the external duties of religion he was uniformly exemplary. He regularly attended church and went to mass; and every Sunday he distributed a Louis among the neighbouring poor.

In the year 1743, Buffon was admitted a member of the French academy, and at his admission he delivered a discourse, entitled, *Phylosophical Remarks upon Style*, which was regarded as one of the finest specimens of composition. In 1752, he married Mademoiselle de Saint Belin, by whom he had a son, who seems to have inherited a portion of his father's talents. In the gardens of Montbard he erected a simple column in honour of his father, with this inscription:

> Excelsæ turri humilis columna
> Parenti suo filius Buffon, 1785.

On seeing this monument, Buffon burst into tears, and said, "Son, this will do you honour." In the year 1795, this young man was condemned to death by the Revolutionary Tribunal; and when he mounted the scaffold, he exclaimed, with dignity and composure, "My name is Buffon!"

After Buffon had completed his History of Quadrupeds, a severe indisposition, which lasted nearly two years, interrupted the progress of his labours, and prevented him from finishing his History of Birds, the two first volumes of which appeared in the year 1771. In this work he received great assistance from M. Guenaud de Monbelliard, whose mode of thinking and writing could scarcely be distinguished from his own. The third, fourth, fifth, and sixth volumes were the joint production of both these naturalists; and the labours of each were marked out by their own names. In the seventh, eighth, and ninth volumes, Buffon was assisted by the Abbe Bexon, who formed the nomenclature, and drew up the greater part of the description.

In 1771, Louis XIV. conferred upon Buffon a singular mark of his favour, by erecting his estate into a compté and granting him the smaller customs.[*] The French king was even anxious to be particularly acquainted with Buffon, and after inviting him to Fountainbleau, where he consulted him on several points relative to the cultivation of wood, he offered him the administration of all the forests in his dominions, a situation which Buffon refused to accept.

In 1773 and 1774, he published in two vols. 4to a supplement to his Natural History, containing an introduction to the History of Minerals. In 1777, he added a supplementary volume to his History of Quadrupeds; and in the same year he published another 4to volume as a supplement to the History of Man. In 1778, he published a fifth 4to volume "On the Epochs of Nature," which is a continuation and an enlarged explanation of his Theory of the Earth; and in 1782, he completed his supplements by a sixth 4to volume on Quadrupeds.

In the prosecution of these labours, by which the science of natural history has been so greatly enriched, Buffon was indefatigable in his application, and in general employed fourteen hours every day in his study. Even in his early life, when he frequented the evening parties at Paris, and did not return to Montbard until 2 o'clock in the morning, he ordered a boy to call him at five, and to drag him out upon the floor if he shewed the least disposition to linger in bed. After he was dressed, he dictated letters, and regulated his domestic affairs; and at six o'clock he resumed his studies at the pavilion, called the Tower of St. Louis. This pavilion was situated at the extremity of the garden, about a furlong from the house; and the only furniture which it contained was a large wooden secretary, and an arm-chair. No books or pictures relieved the naked appearance of the apartment, or distracted the thoughts of its learned possessor. The entrance was by green folding doors, the walls were painted green, and the interior had the appearance of a chapel, on account of the elevation of the roof. Within this was another cabinet, where Buffon resided the greater part of the year, on account of the coldness of the other apartment, and where he composed the greater part of his works. It was a small square building, situated on the side of a terrace, and was ornamented with drawings of birds and beasts. Prince Henry of Prussia called it the cradle of natural history; and Rousseau, before he entered it, used to fall on his knees and kiss the threshold. At nine o'clock Buffon usually took an hour's rest; and his breakfast, which consisted of a piece of bread and two glasses of wine, was brought to the pavilion.[†] When he had written two hours after breakfast, he returned to his house. At dinner he spent a considera-

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[*] This act of the French king has been generally misunderstood. In one of his letters to Mr Smellie, Buffon himself observes, "You likewise say that the king ennobled me, as a mark of his satisfaction with my work. I assure you, that I was noble before, as well as my ancestors, and that the king only granted me another title, (*un titre de plus*) in erecting my estate into a compté." Kerr's *Life of Smellie*, vol. ii. p. 132, 138.

[†] The following account of Montbard is given by Millin, in his *Travels through the South of France in* 1804 *and* 1805. The anecdotes are extremely interesting, and could not easily have been transfused into the text.

"We were introduced by Lapierre, who had been gardener to the Count de Buffon during 43 years, and still takes care of this place, for the widow of his unfortunate son. The house seems the large habitation of a tradesman, rather than the residence of a man of rank. It is in the High Street, and the court is behind. You ascend a stair case to go into the garden, which is raised on the ruins of the ancient mansion, of which the walls make the terraces. On the top, there still remains an octagon tower, where Buffon made his observations on the reverberation of the air. The elevation of this tower is 140 feet above the level of the little river Braine, which crosses the town. This singular and picturesque garden, is well worthy of the notice of the curious. It is not so well taken care of as in the time of its illustrious proprietor; but the numerous foreign trees which he had collected, form several agreeable arbours. The kitchen garden is to the south-west, on seven different terraces.

"Lapierre showed us all those places in which his master most delighted; and particularly the room in which he laboured during the heats of summer. It is in a pavillion, which is called the Tower of St Louis. Lapierre made us, above all, take notice of another closet, situated on the side of a terrace. Buffon used to reside there a great part of the year, because the other place was too cold. From this pavillion, the prospect extends to a plain, separated by the river Braine, and bordered by hills, which make a beautiful scenery. It was there that Buffon composed most of his works. He used to rise with the sun, make fast the shutters and the doors, and work for two hours by the light of wax-candles. In the time of Buffon, this study was ornamented with drawings of birds and beasts. What pleasure we should have had now to have contemplated those representations; to have seen the old leather chair; the table of black birch; the large walnut-tree secretary which decorated this apartment; the old elbow chair in which Buffon used to sit ble portion of time, and indulged in all the gaities and trifles which occurred at table. After dinner, he slept an hour in his room, took a solitary walk, and during the rest of the evening, he either conversed with his family or guests, or sat at his desk examining the papers that were submitted to his judgment. At nine o'clock he went to bed, to prepare himself for the same routine of exertion and pleasure. In this manner were spent no fewer than fifty years of his life, which were not marked by many of those occurrences which give variety to the lives of less recluse and more active philosophers. With a strong constitution, he was for a long time exempted from those debilities which old age generally brings along with it; and, though tortured by the cruel disease of the stone, which shortened his existence, he continued his labours under the severest bodily sufferings; and, to use the expression of Condorcet, it was only for a few days that he ceased to be that illustrious man whose genius and labours had filled Europe for more than forty years. He retained his reason till within a few hours of his death, which happened on the 16th of April 1788, in the 81st year of his age. When his body was opened, no fewer than 57 stones were found in his bladder; and it was the opinion of the faculty, that the operation of lithotomy might have been successfully performed, but Buffon would never consent to this mode of relief. After the body was embalmed, it was presented at St Medard's church, and afterwards conveyed to Montbard, to be interred, according to his orders, in the same vault with his wife. A great concourse of academicians, and of persons of rank and literary distinction, attended the funeral of Buffon; and a crowd of 20,000 spectators assembled in the streets through which the body was to pass. The monument erected to the memory of this distinguished naturalist, was destroyed during the fury of the revolution. The leaden coffin in which he was deposited, was even opened and carried off, and his very remains were left unburied. A citizen who loved the sciences, and who was indignant at this profanation of genius, went to Paris to complain of it, and proposed to the committee of public instruction to place Buffon in the Pantheon. This attempt, however, was unavailing; and the committee were unanimously of opinion, that the place would be profaned by the presence of a man who was connected, like Buffon, with the aristocracy of the country.

In his external appearance, Buffon was distinguished by a fine commanding figure, and his countenance exhibited the most unequivocal traits of superior intelligence. When he walked, he carried his head high, scarcely deigning to look at the ground; and such was the perfection of his general appearance, that the picture of man which he has drawn in his *Histoire de L'Homme* is said to be taken from himself. A love of magnificence and luxury, and even of show, was one of the predominant passions of our author. Even in the latter part of his life, when old age and disease might have subdued this silly passion, he had his hair dressed twice or thrice a day. Every Sunday he exhibited himself in a rich lace garment, attended by his son and by several peasants. His natural vanity was greatly increased, by the admiration which his writings every where inspired. He was in the habit of reciting his works to those who visited him, and of requesting them to read them aloud; and his favourite parts were, the discourse of the first man, successively animated by the developement of his different sensations, the description of the deserts of Arabia in the article *Chameau*, and another description in the article *Kamichi*. His own writings were frequently the subject of his commendation; and when speaking of men of talents, he would often say, that able men were very rare, and that he knew only five great geniuses, Newton, Bacon, Leibnitz, Montesquieu, and himself. The love of glory, however, was the ruling passion of Buffon. It was for this high prize that he laboured during 50 years. The attention which he paid to his style, and the repeated correction and revision which all his works underwent, were less the result of a difficulty which he felt in composing, than of that love of reputation which never forsook him. He tells us, indeed, of the luxuries of genius, and of the gratification with which mental labour always inspired him. "It is for this gratification," said he, "yet more than for glory that I have toiled. Glory comes if it can, and mostly does come. This pleasure is greater if you consult no books: I have never consulted authors till I had nothing left to say of my own." This noble passion, which in the preceding expressions he seems in some measure to disavow, appeared more unequivocally at the close of his life, when he was enabled to anticipate the opinion of posterity. He declared that he had no fear of death, and that the hope of immortal renown was the most powerful deathbed consolation. The vanity of few authors has been so much flattered during their life, as that of Buffon. We have already seen that Louis XV. shewed him the most particular marks of his favour. The Empress of Russia honoured him with her correspondence. She ably criticised some of his opinions, and exerted herself in forwarding his researches in natural history throughout her vast dominions. When Prince Henry of Prussia visited him at Montbard, he wrote these remarkable words: "*Si j'avois besoin d'un ami ce seroit lui; d'un pere encore lui; d'un intelligence pour m'eclair-*

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with the engraving of Newton before him! But the brigands of the revolution envied this luxury to men of letters: they have pillaged this sanctuary of the muses—the simplicity of which ought to have been its protection against their sacrilegious rapacity. We could not be prevailed upon to leave this cabinet; we imagined we saw Buffon in his grey silk night-cap, and in his red night-gown with white stripes; we thought that we heard him intermix with the familiar expressions, 'C'est ça, tout ça, pardieu!' those profound and striking remarks which manifested his genius. We, however, quitted these gardens to see the rest of the town, that we might proceed on our journey early the next morning. In descending, we passed before the column that M de Buffon, the son, raised to the memory of his father. They have permitted it to remain, but have effaced the inscription, which consecrated filial affection.

"Lapierre showed us the house of Daubenton, the assiduous companion of the labours of Buffon, and took us up the same staircase which he ascended every morning at five o'clock, to go to the study that we had just visited. We went to the church, situated on very high ground; we saw not any of the monuments consecrated to the memory of Buffon. The humble tomb which was raised to the memory of his interesting wife, Mademoiselle de Saint Helin, is also no more to be seen. We arrived at the church by a flight of steps, but there is a way for carriages. Near it is a little esplanade, and an alley, bordered with trees. It was here that Buffon, after having assisted at high mass, which he regularly attended, walked in a coat richly covered with lace, escorted by his son, accompanied by Father Ignatius, and surrounded by peasants.

"We should have liked much to see the forges from which the greater part of the revenues of Buffon were derived; but we must have gone a league beyond the town. The sheep-fold in which the illustrious Daubenton made his experiments for the improvement of wool, would also have deserved our attention; but there are no longer any animals kept there."—See Millin's *Travels*, chap. viii.

er, eh ! quel autre que lui." Helvetius and Montesquieu were among the particular friends of Buffon. The Abbé Raynal ranked him above Pliny and Aristotle. Even Voltaire paid due homage to his talents ; and M. Lebrun, one of the finest poets of France, addressed a poem to him highly complimentary to his genius and talents. Such indeed was the extent of his fame, that during the American war, the very pirates transmitted to Buffon the boxes that were addressed to him, while they detained those of the king of Spain.

The social qualities of Buffon were much inferior to those of his mind. There was nothing remarkable in his conversation, though it was on some occasions marked by the peculiar features of his genius. It was probably on this account, that he secluded himself from the gay and learned society of Paris, where his genius would have been obscured amid the dazzling brilliancy of wit and sentiment which were then so conspicuous in the metropolis of France. He often declared his preference of the writings to the conversation of the learned ; and he seems to have acted under the impression, that information should be expected only in the works of authors, and that the common topics of the day were the only proper subjects of conversation. Hence he was fond of trifling in company, and sometimes indulged in a licentiousness of conversation, which often made the ladies blush and retire. While he was dressing, he listened with avidity to the scandalous chronicle of Montbard ; and the Capuchin Ignatius, who often acted as his valet, was in the habit of amusing him with his jokes.

There was very little sensibility in the character of Buffon. In speaking of Rousseau, he observed, "*Je l'amois assez ; mais lorsque j'ai vu ses Confessions, j'ai cessé de l'estimer. Son ame m'a revolté.*" His mind was probably too much occupied with study to enter into the views and feelings of that singular character.

In the moral and religious character of Buffon, we have much to condemn, and very little to admire. When genius appears without the virtues, she is shorne of her loveliest beams. Her dazling splendor may command our admiration, but she wants the qualities which can alone win our affections. Secluded as Buffon was from the temptations of gay life, and devoted wholly to the study of nature, we might have expected some display of the domestic virtues ; but our expectations are sadly disappointed by the history of his private life. His habitual infidelity to his wife was accompanied with most of the vices which generally spring from that odious crime. Delicacy forbids us to repeat what some of his biographers have related on this subject, and what we would fondly hope has been given with some exaggeration.

The whole of Buffon's writings indicate the free sentiments which he entertained respecting religion, though his conversation was more the vehicle of irreligious sentiments than his works. It would neither amuse nor instruct our readers, to detail the Anti-christian sayings which the folly of his friends has divulged, and to which the folly of his biographers has given additional currency. It is sufficient to state the melancholy fact, and to point out the gross inconsistency of his conduct, in performing all the ceremonies and external duties which the religion of his country enjoined. He considered a system of faith as necessary for the multitude, and regarded all those as madmen who openly opposed it ; but it may be fairly questioned, whether this kind of support was not more dangerous, than the avowed hostility of Voltaire and Diderot.

The opposition which Buffon uniformly makes to the doctrine of final causes, and his unwillingness to acknowledge those numerous marks of benevolence and wisdom, which appear in every part of creation, are perhaps more inexcusable than his infidelity. The energy of nature, resulting, as he imagines, from the great laws of attraction and impulse, is with him the cause of all that is sublime and beautiful in the material world ; and if the Creator is accidentally named, he is brought to the bar of human wisdom, and arraigned for all that appears defective in his works, to the shallow penetration of his creatures.

From the moral and religious defects of our author, we turn with pleasure to contemplate the singular genius which is displayed in his works. In his *Natural History*, Buffon has described no fewer than four hundred species of animals. In the anatomical description, he was assisted by the celebrated Daubenton,* but the rest of the work was the production of his own genius. In the first volume, he has given a new theory of the earth, and a discourse on the method of studying and treating natural history. The second and third volumes are devoted to an explanation of his system of generation, and to his history of man, in which he has painted, with all the charms of eloquence, and of the most alluring philosophy, the progress of man under all the various circumstances of his existence. The fourth and fifth volumes contain the history of the domestic animals. The account of carnivorous animals begins the sixth, and is continued through the seventh, eighth, and ninth volumes. The tenth, eleventh, twelfth, and thirteenth volumes, in which Buffon has abandoned every kind of classification, contain the description of individual species ; and the fourteenth and fifteenth volumes are occupied with the history of apes.†

The history of birds he found more difficult to execute than that of quadrupeds, and the interruption of ill health rendered it necessary for him to avail himself of the assistance of his friends. The articles written by Buffon in the second volume, were those on the pigeon, the ring dove, the turtle dove, and some pages of the history of the cock. His articles in the other volumes are marked with his own name ; and one of these in particular, viz. the history of the swan, has been much admired. Buffon read this article to Prince Henry of Prussia, when he visited him at Montbard ; and, as a mark of his delight, the prince sent Buffon a service of porcelain, in which swans were represented in every attitude.

For the particular views of Buffon in geology, and in other branches of natural history and physics, we must refer our readers to his own writings, or to the different articles in our work, in which these subjects will be amply discussed.

In estimating the merits of Buffon as a philosopher and a naturalist, we must withhold from him that substantial praise which is due only to the higher efforts of invention and discovery. The brilliant eloquence and the imposing dignity of his style, have perhaps never been equalled ; but his passion for fine writing has often led him from the path of simple truth, and has given a currency to speculative opinions which profound science will never recognise. His History of Man, his Theory of the Earth, and his Epochs of Nature, contain the finest specimens of philosophical discussion and refined taste; but it is that species of philosophy which amuses and astonishes, not that which instructs and enlightens us. By confounding facts with opinions—by pushing his general views too far—by moulding to his preconceived notions the various facts which would otherwise have overturned them—by attempting, in short, to explain every thing before the progress of science had furnished the necessary materials—Buffon has maintained a series of hypotheses which, in the future history of knowledge, will be regarded only as philosophical romances, to which nothing could have given currency but the magical influence of his eloquence and genius. The mass of authenticated facts, however, which is contained in his works, and the rank to which he has raised the science of natural history, entitle him to that fame which he now enjoys, and to that immortality which he himself anticipated.

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* These descriptions were left out by Buffon in the second edition of his work.

† We have here followed the quarto edition of Buffon's works.

In other branches of general physics, the genius of Buffon was happily displayed. His discovery and explanation of Accidental Colours (see that article), his experiments on the strength of wood,—on the propagation and motion of heat,—and his invention of a burning mirror,—entitle him to high praise, and will be noticed in the different articles of our work. The *Natural History* of Buffon was translated by our ingenious countryman, Mr Smellie of Edinburgh, and was published in 1781, in 8 vols. 8vo., to which a 9th volume was added in 1786. Some of the supplementary volumes were also translated by Mr Smellie, but they have not been given to the world. The *History of Birds* was translated by Mr Leslie, and published in 1793, in nine vols., 8vo. The whole of Buffon's works were lately published at Paris, under the title of *Histoire Naturelle generale et particuliere, Nouvelle Edition, accompagnée de Notes, et dans laquelle les Supplemens sont inseres dans le premier texte, a la place qui leur convient*. Redige par G. S. Sonnini, in 113 vols. 8vo. The work is thus divided:

Theory of the Earth,	4 vols.	Birds, - -	28 vols.
Minerals, -	12	Reptiles, -	8
Animals, - -	18	Fishes, -	13
Apes, - -	2	Cetaceæ, -	1
Insects, - -	12	Man, -	2
Mollusca, - -	4	Plants, -	9

See Peltier's *Paris, pendant l'Annee* 1795 *et l'Annee* 1796. *Oeuvres de Vicq D'Azyr*, tom. i. p. 7, 41, 57; Kerr's *Life of Smellie*, vol. ii. (β)

BUFFONIA, a genus of plants of the class Tetrandria, and order Digynia. See Botany, p. 121.

BUGIA, or Boujeiah, a sea-port town of Algiers, and formerly capital of a province of the same name, is built on the ruins of Salda, at the bottom of a high mountain, looking towards the north-east; and is watered by the river Huet el Quibir, supposed to be the Nasava of Ptolemy. It is surrounded with a stone wall, and strongly defended by a castle, which stands on the summit of the mountain, and a garrison of nearly 300 Turkish soldiers. This force, however, is unable to repress the disorders and depredations of the savage tribes who dwell in the neighbourhood, and who often commit, in the very heart of the city, the most flagrant acts of rapine and barbarity. These tribes generally attend the market with oil, wax, dried figs, &c. and during the morning are very peaceable and regular; but the day seldom closes without confusion and outrage. The harbour of Bugia is formed by a neck of land, jutting out into the sea, and is defended by two forts. The principal trade of the inhabitants consists in ploughshares, spades, and other instruments of agriculture, which are manufactured from the iron supplied by the adjacent mountains; and considerable quantities of oil, wax, &c. the produce of the surrounding country, is shipped here for the Levant. This town submitted to the Spaniards in 1510, and five years after resisted all the attacks of the corsair Barbarossa; but it was retaken by the Algerines, after the luckless expedition of Charles V. in 1541. It was bombarded in 1671, by Sir Edward Spragg, who greatly damaged the town and castle, and killed many of the inhabitants. Bugia is 80 miles east of Algiers. N. Lat. 36° 34′, E. Long. 5° 10′. (L)

BUGINVILLEA. See Botany, p. 197 & 266.

BUILDING. See Civil Architecture.

BULAMA, Bulam, or Boolam, the most eastern island of the Bijuga Archipelago, on the western coast of Africa, lies in N. Lat. 11° 8′, and W. Long. 14° 50′. It is situated on the north west of the embouchure of the Rio Grande, and is separated from the main land on the east by a channel, which forms an excellent and capacious harbour about two miles wide, with a good clear bottom, and water sufficient for the largest ships to ride in safety within a cable's length of the shore. The length of this island is about seven leagues, and its breadth varies from two to five.

Bulama rises from the sea with a gentle ascent for the space of two leagues, to a few hills, serving as the basis of some considerable mountains in the centre of the island, which are crowned with woods, and interspersed with luxuriant vallies. It is enriched with lofty fruit and forest trees, forming a verdant belt, in some places two or three miles broad, and is intersected by several rivers, which, issuing from the mountains, beautify and fertilize the country. Whatever is required for the necessaries, the comforts, or even the luxuries of savage life, are here produced in great profusion; and, independent of the climate, there are few countries better calculated, both by its situation and productions, for all the purposes of a rich and extensive commerce. Lying in the vicinity of many navigable rivers, which extend far into the continent, and which would greatly facilitate a trade with the internal parts of Africa; and possessing a deep and luxuriant soil, adapted to every species of cultivation, it offers itself as a most desirable settlement to any European nation. Cotton, indigo, coffee, and rice, are its spontaneous productions; and pine-apples, limes, oranges, grapes, plums, cassada, guava, Indian wheat, melons, pumpkins, tamarinds, bananas, and many delicious fruits, grow here in great abundance. Sugar and tobacco, and indeed all the other productions of our West India islands, may also be cultivated here in equal perfection; and, considering the richness of the soil, to much greater advantage.

"The island," says Captain Beaver, "is covered with wood of various sizes and grain; from that of the majestic oak, to the most diminutive shrub; and from the close texture of the iron wood, to the soft porous grain of the pullam or cotton tree." From these, great advantages may be derived both in the construction of houses and in the building and repairing of vessels. The *macheiry*, of which the naturalized Portuguese in this part of Africa construct their decks, is very easy to work, is never perforated by worms, and is deemed preferable to what is generally employed for this purpose. In the marshy spots are produced a particular species of wood, the inner bark of which is made into a kind of tow which never rots; and also a species of reed, from which very good cordage is manufactured by the negroes.

On the southern side of the island are extensive savannahs, or natural meadows, well stocked with oxen and wild horses; and stags, goats, buffaloes, and elephants, are to be found in great numbers; while the lion, tiger, jackal, and other beasts of prey, except the hyæna, though natives of the neighbouring continent, are unknown in Bulama. Vast flocks of game are seen all over the island; and doves, guinea fowls, and various other birds celebrated for the beauty of their plumage, breed undisturbed in the woods. The shores, also, afford a great variety of fish, particularly plenty of excellent turtle.

The climate, as must be expected from the latitude of the place, cannot but be insalubrious; but it might be greatly improved by clearing and cultivating the country. According to Captain Beaver's observations at noon, the thermometer was never lower than 74°, and seldom higher than 96°, the medium temperature being 85°. A fine sea-breeze which sets in about mid-day, renders the evenings temperate and pleasant; and the general difference between the temperature of noon and night, is from 20 to 30 degrees. The dew, which begins to fall immediately after sunset, produces a sort of chilliness in the air, which would induce some to put on warmer clothing, and even to light a fire in their houses; and the absence of the sun for twelve hours, which gives the earth time to cool, renders the mornings equally agreeable. The rainy season generally begins about the month of June, and continues until the middle of October. During this period, however, there are often considerable intervals of clear weather, particularly in the first and last months; but towards the middle of the season, the rain falls in perfect torrents. The approach and conclusion of these rains are generally indicated by tornadoes, which arise chiefly in the eastern part of the compass. These, however, are neither so violent nor so destructive, as those terrible hurricanes which are so frequently experienced in the West Indies. They always give sufficient warning of their commencement, so that every precaution may be taken against their influence; and their usual duration is from one to three hours. Their beneficial effects are of the utmost consequence in these countries. They conduce greatly to the salubrity of the climate, by purifying the air, and by dispelling all those deleterious vapours with which it would otherwise abound. They begin about the middle of May, and are most frequent in the months of September and October, and cease about the beginning of November. The *seasoning* fever in Bulama, to which every stranger is subject, is much the same as that of the West Indies, though it has been represented by some as much more dangerous and malignant; and it has even been maintained by a respectable physician,* that the yellow fever was originally brought to the West Indies from the island of Bulama.

The original inhabitants of Bulama were the Biafaras, (see Biafaras,) who, after a long and sanguinary war, were expelled by the Bijugas, a warlike nation, inhabiting the neighbouring islands. The time of the Biafara expulsion is not exactly known, but it must have taken place previous to the end of the 17th century; for when the French visited the island in 1699, it was entirely uninhabited. The Bijugas, instead of residing on their new conquest, contented themselves with visiting it every year for the purpose of hunting. They here procured elephants tusks, which they bartered with the Portuguese for tobacco, rice, guns, powder, and shot. With the skin of the buffalo they covered their shields, and that of the deer supplied them with their only clothing. A few fields of rice, millet, and other pulse, were annually cultivated on its western end; and immediately after harvest, which was always plentiful, they returned to their own country. This island, since its first discovery, has often attracted the attention of Europeans. It was strongly recommended to the French government by M. de la Brue, director-general of the French Senegal Company, who visited it in 1700, as a most eligible situation for a colony; and about 60 years after, the recommendation was repeated by the Abbé Demance, who lived for some time on the adjacent coast; and also in 1787, by Barber, an Englishman, then residing at Havre de Grace. Their schemes, however, were never put in execution, and the breaking out of the revolution prevented that power from looking beyond its European dominions. During the agitation of the question respecting the abolition of the slave trade, the attention of the English was often directed to the civilization of Africa, as the best means of accomplishing that benevolent object. With this generous intention was formed the Sierra Leone Association, (see Sierra Leone)—and, with a similar design, a settlement was proposed to be established on the island of Bulama, which was carried into execution in 1792. Of the views, progress, and failure of this unfortunate expedition, Captain Beaver has furnished us with a very minute account in his *African Memoranda*, to which we must refer our readers for the particular details; and shall confine ourselves, in the remainder of this article, to a succinct sketch of the more prominent circumstances which led to its unsuccessful issue. The object of those gentlemen who were the original promoters of the scheme, according to Captain Beaver, was purely the civilization of the Africans; and the method which was proposed for the attainment of this desirable object, was the cultivation of the country by free natives, hired for the purpose, by which they might be induced to habits of labour and of industry, and by opening a commercial intercourse between Europe and the African continent, which might eventually lead to the introduction of religion, letters, and civilization, into the very heart of the country, and thereby raise that degraded people to their proper rank in the society of nations. We cannot enough admire the disinterested spirit which dictated this benevolent design; and we have to regret, that it was undertaken with so little precaution, and with such inadequate means.

The expedition, consisting of three vessels, the Calypso, Hankey, and Beggar's Benison, with the colonists on board, consisting of above 280 souls, men, women, and children, sailed from the Downs on the 6th of April 1792. This expedition was entrusted to the command of Captain Dalrymple, and a council of 12 gentlemen, the greatest number of whom had been officers in the navy or army. On the 25th of May, the Calypso, having parted from her consorts, anchored off the island of Bulama. The colonists, unaccustomed to the confinement and deprivations of a sea-voyage, were eager to get on shore, and to take possession of their new habitation. But instead of endeavouring to secure the friendship of the natives, or to purchase the island, as was their original intention, they landed without order or precaution, seemingly regardless of their own safety, or of the authority of their commanders. Every one did whatever he pleased. Some erected huts and tents; others wandered through the woods in search of game and fruits, and returned to the ship or not as they thought proper in the evening. During the first night, their tents, and whatever they had left on shore, were carried off by the natives, which roused them a little to a sense of danger, and induced them to erect a large shed, inclosed with planks, as a place of residence and defence. But the same irregularity prevailed. Captain Dalrymple had either lost all influence and controul, or had not firmness to exercise it. The colonists became turbulent and unruly, and confusion and anarchy reigned in every quarter. Instead of being prepared against any unforeseen circumstances that might happen, or pursuing such measures as were necessary for the success and preservation of the colony, they were scattered over the island, each in pursuit of his own favourite amusement. The Bijugas had watched all their motions, determined to assert their right to the island; and at mid-day on Sunday the 3d of June, while some of the colonists were asleep, and others hunting and fishing, they made their attack. They fired a volley into the hut which contained the arms of the colony. Those that were within, being roused from their sleep, rushed out, and were immediately shot. The rest, unprepared and unarmed, upon hearing the firing, hid themselves among the rocks, or attempted to gain the beach; by which means the greatest number escaped, while others were intercepted and taken prisoners. The English in this melancholy affair had five men and one woman killed, four men wounded, and four women and three children taken prisoners; and the savages retired with a rich booty of sixty stand of arms, and a quantity of ammunition, besides kitchen utensils, wearing apparel, and other European articles. Consternation and dejection succeeded, and the confidence of the colonists was now converted into the most groundless fears. No attempt was made to recover what they had lost; and after landing a party of armed men (under a discharge of cannon from the ship) to bring off their water casks, the Calypso, early the following morning, got under weigh for Bissao, where she was joined by the Hankey and Beggar's Benison. Disappointed and dissatisfied with their situation, mutual irritation and reproaches broke out between the colonists and the members of the council. Each attributed their misfortunes to the other; for while the council was charged with a want of attention to the comfort and interest of the colony, they reproached the colonists with licentiousness and disobedience. These complaints, and the fever which appeared in the Calypso, and had been communicated to the Hankey, reduced the majority of the colonists to despondency. Ashamed, however, of relinquishing their design without another attempt, they returned to Bulama, and having redeemed their captives, they purchased the island from the kings of Carnabol, for the value of 473 bars in goods.* But no sooner was this transaction concluded, than, instead of availing themselves of the right which they had now acquired, the majority of the council determined to abandon the enterprise as at present impracticable; which determination was communicated to the colonists in the following resolution: "That seeing that the rainy season has already commenced, and it appearing, from every information we can collect, that we cannot land because of the rains and fogs at least for four months, and that with every precaution there will probably be a considerable mortality among the settlers during that time, and considering withal, that a great proportion of the adventurers in each ship are solicitous to return to Europe, it is the opinion of the council, that the two ships and the sloop should be removed to Sierra Leone to water, and there the expediency of proceeding to England, or of returning hither after the rains, shall be taken into consideration." Against this resolution Captain Beaver entered his protest; and declared to the council, that he was determined to remain on the island, with his servant, though every one else should leave it: and in this determination he was joined by *one* of the council, and between 80 and 90 of the colonists. It was then agreed that the Hankey and Beggar's Benison should remain at Bulama, and that the Calypso should immediately proceed to Sierra Leone, with those who were desirous of returning to England. The settlers were thus reduced to a third of their original number, and when mustered by Captain Beaver, who was unanimously chosen their president, were found to consist of 48 men, 13 women, and 25 children. Having adopted proper regulations for maintaining subordination, sobriety, and discipline in the colony, and having established a friendly communication between Bulama and the Portuguese settlement on the island of Bissao, the first care of the colonists was to protect themselves from the heat of the sun, and the violence of the rains, by covering the ship with a wooden roof. They then set about clearing and cultivating a piece of ground for a garden, and built a block-house, which was to serve as a habitation, a general magazine, and a citadel. Both tropical and European plants and seeds succeeded beyond their expectations; and all vegetable productions arrived at maturity with astonishing quickness. Several free negroes had been hired to assist in the work. They were well treated, and always allowed to leave the island, whenever dissatisfied either with their masters or their employment; and during the residence of the English at Bulama, 196 of these Africans had been employed on the island. Many of the surrounding tribes also visited the colony, who always came with a view to trade, and brought with them something to dispose of. But in all their dealings with these negroes, the colonists observed the strictest integrity, never shewing the least desire of over-reaching them in the exchange of their commodities. By these means, and by rigorously adhering to their determination of never being concerned in the purchase of slaves, they soon gained the good-will and confidence of the natives, without which they never could have kept possession of the island. Sickness and disaffection, however, had spread among the settlers, and their numbers were daily diminished by desertion or death. To such a state were they sometimes reduced, that there was scarcely an European fit for work, or to give directions to the negroes; and out of the 86 which staid in the island after the sailing of the Calypso, within nine months ten only were left. These were at last reduced to nine, who became so dispirited and overcome with sickness, that the whole affairs and business of the colony rested with Captain Beaver himself.

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* Dr Chisholm, in his "*Essay on the Malignant Pestilential Fever*," &c. 8vo. 1795.

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* L. 78. 16s. 8d. sterling.

Whatever the energy and perseverance of one man could do was done by this officer. He encouraged his countrymen to exertion by his example; supplied their wants, and soothed them in their sickness. He often cheered them with the hope of succours from England; but all would not do. Fear and despondency had taken possession of their minds. They saw only certain death if they remained; and after repeated solicitations to return home, and even threatenings to leave the island, Captain Beaver was at last prevailed upon to accede to their request, and quitted Bulama on the 29th of November 1793. Thus vanished the benevolent enterprise of the Bulama association, of whose success the most sanguine expectations had been formed, both by its promoters and their friends in England. But when we consider the difficulties of the undertaking, and the character of those who were engaged in it, we are not surprised at its failure. The establishment of an infant colony requires resources, which few private associations are able to supply; and a prudent unanimity, and determined courage and perseverance, in those who are entrusted with its execution, which are not often to be found. Prejudice and self-interest sometimes accompany the most distinguished talent; and the public good is often forgotten when it comes in competition with private advantage. The Bulama expedition was deficient in both these respects. Many of the colonists were men of the most infamous character, and vicious habits, who had neither industry, fortitude, nor honesty; and many of the council, indeed we may say all of them excepting Captain Beaver, were destitute of that perseverance and firmness of mind, necessary for enforcing subordination and obedience; and their desertion of the enterprise without a sufficient cause, cannot be too severely reprobated. The time for the sailing of the expedition was also very unfortunately chosen. They must have known that they could not have arrived at Bulama before the commencement of the rains, which in that country is the most unhealthy season of the year; and which could not but prove most injurious to men accustomed to shelter and a temperate climate; and it is to this circumstance, and to their want of every necessary to protect them against the inclemency of the season, unless what they procured by long and hard labour from the island, must, in a great measure, be attributed that mortality, which swept away such a number of the settlers. The want of timely supplies, both of men and necessaries, must have been severely felt; and had Captain Beaver been seconded by the committee in England, as his exertions and perseverance deserved, this colony might have been preserved; and those benevolent purposes for which it was established, might, to a considerable degree, have been accomplished. We hope, however, that this design is not entirely relinquished; but that the time will soon come, when, supported by the bounty of government, which has been so liberally extended to the settlement at Sierra Leone, a colony shall be established at Bulama, which shall disseminate the blessing of civilization, liberty, and religion, among the oppressed and benighted Africans. See Beaver's *African Memoranda*, passim; Durand's *Voyage to Senegal*, p. 66; Wadstrom's *Essay on Colonization*, p. 130; Golberry, *Fragmens d'un Voyage en Afrique*, vol. ii.; Labat, *Relation de l'Afrique Occident.* (L.)

BULB. See Botany, p. 49.

BULBOCODIUM, a genius of plants of the class Hexandria, and order Monogynia. See Botany, p. 180.

BULGARIA, Little, formerly a small kingdom, now a province of the Turkish empire, is bounded on the west by Servia, from which it extends along the banks of the Danube, which is its northern boundary, to the Black Sea on the east; and is separated from Macedonia and Romania by Mount Hæmus on the south. It is about 72 German miles in length, and 20 in breadth, except towards the east, where it stretches along the Black Sea nearly 40 miles. This province constitutes the eastern part of the ancient Mysia, and received its present name from the Bulgarians, who settled here about the end of the seventh century. These barbarians, allured by the Roman wealth, left their native seats on the banks of the Volga, and ravaging with ruthless fury the countries through which they passed, broke into Thrace, and filled the whole empire with consternation. Notwithstanding repeated checks and defeats from the Roman generals, they still continued their annual irruptions, carrying off immense booty from the plundered provinces; and, near the close of the reign of Justinian (A. D. 560), Zabergan their chief, with seven thousand horse, passed the Danube, and pitched his tents at the distance of 20 miles from Constantinople. The forces of the empire were employed on the distant frontiers; crowds of clamorous rustics surrounded the city, imploring food and protection; and Justinian trembled for the safety of his capital. But the arm of Belisarius was raised for the last time in its defence. At the head of 300 veterans, and a tumultuary band of citizens and peasants, Belisarius advanced against the enemy. The shouts of the multitude dispirited the barbarians; and the desperate assault of the aged general and his guards threw them into confusion. The Bulgarians were routed; and, after extorting heavy ransoms for their prisoners, and wasting the summer in the plains of Thrace, they were compelled to repass the Danube. Not discouraged by their frequent defeats, they repeated their devastations, and looked upon themselves as amply compensated for any loss they might sustain in battle, by the plunder which they collected in their march. In the reign of Constantine Pogonatus, a more numerous horde entered the Roman territories, and ravaged at pleasure the northern provinces of the empire. The forces of the emperor were unable to oppose them; and Constantine at last consented to a dishonourable peace, and agreed to pay an annual tribute to his invaders, upon condition that they should discontinue their inroads, and assist him against all his enemies. It was about this time that they settled in lower Mysia, and established the kingdom of Bulgaria—some say with the consent of Constantine, while others allege that they had formed a settlement in that province several years before the commencement of his reign. But his successor, Justinian II., refusing to acquiesce in the stipulated treaty, withdrew the promised tribute, and, invading their country, reduced them to great distress. The triumph of Justinian, however, was but of short duration. His army was unexpectedly attacked by the Bulgarians, who gained a complete victory, and compelled him to confirm the treaty of his father. From that time an incessant warfare, interrupted by short intervals of precarious peace, was waged between the Romans and these restless intruders, until the beginning of the tenth century, when the Bulgarians had added to their dominions, by war or treaty, the provinces of Dardania, Thessaly, and the two Epirus's; and the obscure town of Lychnidus had been converted into the capital of the Bulgarian king. Their manners had been softened by their intercourse with the Greeks, and the introduction of the Christian religion; and Simeon, the heir of the throne, was educated in the schools and in the religion of Constantinople. Under his government, Bulgaria began to assume a name among civilized nations; and his genius and valour rendered her the terror of the neighbouring kingdoms. The Romans had been dispirited by repeated defeats; Adrianople was in his power; and preparations were making for the siege of the capital. But the progress of Simeon was arrested, by a demand for a personal conference with the Emperor Romanus. The Bulgarian dictated the conditions of peace; and the reconciliation was sealed by a domestic alliance. This friendship, however, was soon disturbed by the death of Simeon, with whom also died the glory and independence of Bulgaria. His feeble successors were consumed by dissension, and presented their country an easy prey to the first invaders.

The Russians, who had also been incited to foreign conquest by the fertile regions of the south, landed an army of 60,000 men on the shores of the Danube, and entering Bulgaria, ravaged the country with fire and sword. In a desperate encounter, the Bulgarian horse yielded to the swords of the Russians with the loss of their king and the captivity of his children. Swatoslaus, the Russian chief, now advanced to the south. He invested the city of Adrianople in spite of the remonstrances of the Roman emperor, and even threatened the capital itself. But his numbers were unable to withstand the attack of 12,000 Romans, under the command of the valiant Zimisces. Marcianopolis was taken by storm, and 8500 Russians put to the sword. The sons of the Bulgarian king were rescued from prison, and invested with the diadem of their father; and Swatoslaus was compelled to take refuge in the strong fortress of Dristra, on the banks of the Danube, and at last allowed to escape only by the generosity of his conqueror. The Bulgarians immediately submitted to their deliverer. But their submission ended with his life in 975, when they shook off the Roman yoke, and renewed their former devastations in the empire. After a long and doubtful struggle, the emperor Basil at last prevailed, and was honoured with the surname of the Slayer of the Bulgarians. His avarice was gratified by ten thousand pounds weight of gold, which he found in the palace of Lychnidus; and his vengeance was satiated, by depriving 15,000 captives of their sight, except one of each hundred, to whom he left a single eye, that they might conduct their blind century to the presence of their sovereign. This terrible example awed the nation to obedience; and their king is said to have died of horror and grief, at the sight of his wretched subjects. Dispirited, and circumscribed within a narrow province, they continued for nearly two centuries the patient subjects of the Roman emperor; and, on account of their powerful assistance against the Turks and Latins, they were allowed to choose a king of their own nation, who acknowledged himself a vassal of the empire. The Eastern empire, however, was fast hastening to decay. Its schism with the Latin church, and the profligacy and rapacity of its princes, presented a favourable opportunity for throwing off their subjection. The Bulgarians had been exasperated by the plunder of their flocks and herds, which had been carried off to supply the luxuries of the royal table, and by the denial of equal rank and pay in the military service. Their former injuries had long been remembered in silence, and were aggravated by the present insults; but the arms and policy of their sovereign Calo-John delivered them from oppression, and firmly established the independence of the kingdom. He renounced all submission to the religion, as well as to the laws of Constantinople, and, dispatching an embassy to Pope Innocent III., acknowledged himself a disciple of the Latin church; and received from the Vatican a royal title, a Latin archbishop, a holy banner, and the licence of coining money. His enmity to the Greeks, however, was soon turned into compassion and alliance. Upon the subversion of that monarchy by the Latins, in 1204, and the accession of Baldwin, count of Flanders, to the empire of the East, Calo-John, as a votary of the pope, claimed the honour of being a friend and associate; but his ambassadors were dismissed with a haughty message, that their rebel sovereign must deserve a pardon, by bowing before the footstool of the imperial throne. The Bulgarian suppressed for a while his resentment, but cherished the insult. He inflamed the discontent of the Greeks, and promised them his friendship and support. He joined to his own forces a body of 14,000 Tartars, which he had drawn from the Scythian wilderness; and when the flower of the emperor's army was transported beyond the Hellespont, the signal was given for the general massacre of the Latins. Adrianople was taken. Baldwin, who had come to besiege the rebels, was defeated and taken prisoner; and the remainder of his troops were saved from destruction, by a masterly retreat of three days, to the shores of the Propontis. The success of the Bulgarians continued till the jurisdiction of the Latins was confined to the capital and a few adjacent fortresses; but his career of victory was stopped at the siege of Thessalonica, where he fell a victim to domestic treason, being stabbed during the night in his tent. His successor was unable to prosecute his schemes of ambition and revenge; and, after several defeats, the Bulgarian king was compelled to conclude an honourable peace with the successor of Baldwin. The independence of Bulgaria, however, was not of long continuance. In 1275, Stephen IV., king of Hungary, having vanquished and cut to pieces the army of the Bulgarians, compelled them to acknowledge him as their sovereign. But revolting from the Hungarians, and joining with the emperor of Constantinople against the Turks, they were totally defeated by Amurath I., whose successor, Bajazet, completed the conquest of the whole country in 1396, and reduced it to a province of the Turkish empire, in which state it has ever since remained. See TURKEY.

Bulgaria is divided by the Turks into four Sangiakships, viz. Widin, Sardice, Nicopoli, and Silistria, with each a capital of the same name, except Sardice, which is now called Sophia. The other principal cities are Cistow, Rousdjiouk, Orsowa, Babadag, Toultcha, Rasgrad, Bazardjik, Choumla, Ternova, Varna, Lovatz, &c. This province is in general mountainous, but the plains and vallies, which are watered by the Danube and numerous tributary streams, are rich and fertile. Even in the mountains, nature has spread many of her richest gifts. The forests of Mount Hæmus abound in a variety of fruit trees, particularly cherries, apricots, and vines; and in its deep glens and uninhabited recesses, aromatic shrubs and the gayest flowers are as numerous and exquisite, as in the most cultivated gardens in our less genial soil.

The chief productions of Bulgaria are grain of all kinds, cattle, especially horses, wool, iron, and wine, which form a very extensive and lucrative commerce;

and the navigation of the Danube, which is performed by small boats, affords it an easy communication with the neighbouring provinces, and the ports on the Black Sea; but as the commerce of this province, especially its imports, will be more particularly considered in the account of its principal cities, we shall confine ourselves in this article to a general description of its productions and exports. The exportation of corn out of the kingdom is rigorously prohibited, so that the capital is its principal market; and from the immense quantities which are annually carried down the Danube, this river is called by the Turks, the Foster-father of Constantinople. Wheat, in common, sells for 36 paras the *quilot*, which, in the southern districts of Bulgaria, weighs 48 okas; but, in the northern parts, the quilot weighs 120 okas, and costs there only 60 paras. Rice, barley, and millet, sells for from 45 to 50 paras, and sesame from 65 to 70. The greatest quantity of rice grows in the territory of Philippopoli. It is a farm of the Grand Signior's, and the rice is given away chiefly in the payment of pensions, which are specified by a certain number of quilots per day. The wool that is gathered in Bulgaria is of a very excellent quality, particularly that of Nicopolis, which sells for from 8 to 10 paras the oka; and which, by proper management, might be made even to equal the wool of Spain. What is produced in the southern part of the province, passes to Constantinople; but that of the north is spread over Germany and the ports of the Adriatic. Its silk is also very abundant, and constitutes an important article of commerce with the capital. The silk of the best quality, which comes from Zagara, Tchirpan, and Kizanlik, is nearly ten piastres the oka, while the silk of Haskeni sells for eight. The Bulgarians owe the increase of this article entirely to the inhabitants of Brousse in France, who have come to settle in the country, and who have planted a prodigious quantity of mulberry trees. The honey of this province is superior in quality to that of Wallachia or Moldavia. The best comes from the neighbourhood of Yamboli, which sells for about eight paras the oka; but its exportation is prohibited, except to Constantinople; and though very abundant, it is with great difficulty that it can be smuggled into any of the ports on the Black Sea. Wax is sold here pure and unadulterated. It is yellow, and of an excellent quality, and is gathered in great quantities at Ternova, Yamboli, Nicboli, Cistow, Rousdjiouk, Toutraka, Silistria, Prevat, Bazardjik, Zagara, Tchirpan, Choumla, and Rasgrad. The tobacco of this province varies greatly in quality. The best, which comes from Yenidjé sells from 12 paras to as high as a piastre the oka; that of Koumarlu, from eight to ten paras; and that of Kirdjali, a little cheaper. The fourth quality, which is called *kisil deli*, is a very strong tobacco, which is exported to Egypt and Arabia, and sells at eight or nine paras the oka. The wine of Bulgaria is rather of an inferior quality. It is, however, made in considerable quantities; and between five and six thousand waggon loads are yearly carried to Russia and Poland, which commonly costs about 50 paras the quintal. The immense quantities of tallow, which are collected in this country, is contraband every where throughout the kingdom, except at Constantinople, Adrianople, and Rodosto; and butter, which is made in great plenty on the shores of the Danube, is hoarded up entirely for the use of the capital. Bulgaria carries on a considerable trade in hides. Those of the buffalo weigh from 18 to 70 okas, and sell at from 2 to 13 piastres; and the price of ox-hides, which weigh from 12 to 25 okas, is from 1½ to 3½ piastres. It has also considerable manufactures of Morocco leather, and sheep skins of all colours, particularly at Rousdjiouk, on the Danube. Its horses, particularly those of Dobrogé, are very much esteemed. They are small and strong, like the Tartar horses, but much better shaped. Iron is a principal article of commerce in this province. The mines of Samakow and Keustendil are very extensive, and supply Constantinople and all the districts on the Black Sea. These mines are farmed by the Grand Signior, and the metal sells upon the spot for from 4½ to 5 piastres the quintal. Its wrought iron is also greatly sought after, particularly the pistol and musket barrels of Selimna, which are equal to those of Constantinople; and the prodigious quantities of horse-shoes and nails which are made at Sophia, are scattered over the whole Ottoman empire. Saltpetre, of a very good quality, is gathered at Philippopoli, Bazardjik, and Yamboli. A new branch of commerce has lately been formed in Bulgaria, consisting of hare skins, of which great quantities are exported from Adrianople to France: and such is the demand for this article, that at Marseilles it brings from 4 to 5 livres per pound. But if the demand continues, the quantity must soon be diminished; for the Bulgarian peasants, who find hare-hunting such a lucrative concern, will not stop until they have considerably lessened their numbers, perhaps destroyed the species.

The commerce of Bulgaria was long in the hands of the Ragusians, who had large establishments at Rousdjiouk, and Sophia, and several other places. These establishments, however, have almost entirely disappeared; and the few Ragusian houses that remain, seem to have very little trade. They were succeeded by the French, who, within these last thirty years, had extended their merchandise over the whole province. Four or five French houses established at Adrianople, received direct from Marseilles the manufactures of France, for which they returned the productions of Bulgaria by the ports of Enos and Rodosto. This trade, however, has suffered greatly by the present war; and the communication with France by sea has been almost entirely destroyed.

The inhabitants of this province, who were formerly distinguished for their military achievements, are now dispirited by oppression, and sunk in ignorance, indolence, and filth. Its political state is now that of the worst state of the feudal system; its numerous lords hold their estates from the pacha or governor, and they are bound to bring so many armed men into the field, whenever summoned by their chief.

Agriculture is here very imperfect; and this country is indebted for its excellent productions, more to the fertility of the soil, than the exertions of its inhabitants. Their towns, in general, cover a great extent of ground, and consist of miserable cottages, each surrounded with a large garden: and their streets exhibit nothing but desolation and dirtiness. The Bulgarian ladies are extremely fond of ornaments, particularly of small pieces of coin, which some wear strung together like fish scales, and plated upon shreds of gold thread, tied in bunches; and others interlace them with their braids of hair. According to the account of an intelligent traveller who lately visited that country, " they have many of gold; and it is asserted, the more rare of the imperial or ancient Greek coins have been frequently discovered by travellers so applied, and as having been transmitted from the remotest generations. They wear them, too, sewn on ribbands appendant to their head-dress, and hanging down to their heels. They cherish, as a very favourite ornament, broad clasps of silver gilt, fastened about two thirds round each arm, as bracelets. So religiously are their coins preserved, that no rank of life is scarcely so mean as to be deprived of them; and it is not uncommon to see even children, naked and hungry, decorated with these pieces of money, the value of which would clothe and feed them for a year." The mountains are the retreats of numerous banditti, who infest the whole country, and seize all they can meet with as plunder; and such is the perpetual alarm which they excite, that the shepherd and husbandman seldom venture into the field without a pistol and dagger at their girdle. The Bulgarians are mostly Cristians of the Greek church, but they are ignorant and superstitious. They have one patriarch and three archbishops, subject to the patriarch of Constantinople. In the hills south of Sophia, are the ruins of an ancient gate, consisting of two stone pillars, with an arch over them, which is said to have been consructed by the Emperor Trajan, in commemoration of his having marched his army along a road formed by himself through steep rocks and precipices, before impervious; and throughout the whole of the country, sepulchral tumuli are to be seen, which mark the slaughter of the inhabitants, and the progress of the Turkish victories. See Peuchet *Dictionnaire*, &c.; *An Itinerary from London to Constantinople*, p. 60, in Philip's *Coll. of Voyages*, &c. vol. i.; Gibbon's *Roman Empire*, vol. vii. ix. x. xi.; and *Anc. Un. Hist.* vol. xix. (*p*)

BULGARIA, Great, or the duchy of Bulgar, a province of Asia, in Russian Tartary, now incorporated with the Russian empire, and forming a part of the government of Caucasus. It is bounded by the kingdom of Cassan on the north; by Baskiria on the east; by the river Samara on the south, which separates it from the kingdom of Astracan; and is terminated by the Volga on the west. This province is but little known. It takes its name from the capital Bulgar, which is situated near the Volga, and is merely the remains of the ancient city of Briacchinow, and now consists of only about 100 houses, inhabited by peasants. Numerous rivers intersect the country, and lose themselves in the Volga; and the mountains furnish precious stones, iron, and chrystal. See Peuchet *Dictionnaire*, &c. (*p*)

BULL, George, Bishop of St David's, was born at Wells, in Somersetshire, in the year 1634. At the age of four, he was left, by the death of his father, in independent circumstances. Having been early destined for the church, he received a liberal and appropriate education; and such was his progress in classical learning, that he became fit for the university at the age of fourteen. He was sent to Exeter College, in Oxford. There he spent the greater part of his time in pleasure and amusement; but contrived, notwithstanding, to acquire intellectual reputation and respectable patronage among his superiors. In consequence of refusing to take the oath of allegiance to the Commonwealth, he was obliged to leave the university, about seven months after he entered it. He retired to North Cadbury, where he continued for four or five years; during which time, one of his sisters had the merit of weaning him from the vanities to which he had been addicted, and inducing him to prosecute the studies that were peculiar to his views in life. At the age of twenty-one, he was ordained deacon and priest by Dr Skinner, the ejected bishop of Oxford; and soon after became minister of St George's, near Bristol. In that situation he discharged his pastoral duties with singular assiduity and zeal, preaching twice every Sunday, visiting his parishioners from house to house, and labouring by all the means in his power to instruct and reform them. In the livings which he afterwards held, he was characterised by the same exemplary attention to the improvement and interests of his people; and was so much respected and beloved by them, that he prevailed on many to return to the bosom of the church, which at that troublous period was an object of general and inveterate dislike. While rector of Suddington St Mary, in Gloucestershire, which he held for twenty-seven years, he was extremely diligent in theological study, and composed the greatest proportion of his works. In 1669, he published his celebrated book, entitled, *Harmonia Apostolica*. The object of this treatise is, 1. To explain and defend St James's doctrine of justification by works; and, 2. To demonstrate the agreement of St Paul with St James. It is frequently referred to by Arminian and Pelagian writers, in support of their notions respecting the mode of our acceptance with God, and is perhaps as good as any thing on that view of the subject which has yet been produced. Towards the end of the year 1675, he published two defences of his *Harmonia*; one of them, his *Examen Censuræ*, in reply to Mr Gataker; and the other, *Apologia pro Harmonia*, in reply to Dr Tully. All these works, whatever may be thought of their principles, are certainly distinguished both by learning and ability. In 1678, Mr Bull was installed as a prebendary in the church of Gloucester, to which he had been promoted by Lord Chancellor the Earl of Nottingham. Two years after this, he completed and published his *Defensio Fidei Nicenæ*: a work directed against the Arians and Socinians on the one hand, and the Sabelians and Tritheists on the other. It procured for the author great celebrity as a controversialist, both at home and abroad; and has been of considerable service in the disputes respecting the Trinity, which have so long agitated the Christian church. At the same time, while it has been applauded by some as a masterpiece of reasoning and erudition, it has been condemned by others as containing no small portion of malevolence, fraud, ignorance, and sophistry. The author was presented, in 1685, to the rectory of Avening, and very soon after to the archdeaconry of Landaff; and, in consideration of his eminent services to the church, the University of Oxford unanimously made him a doctor in divinity, although he had not previously taken any academical degree. As he had been zealous in the defence and restoration of the establishment, in opposition to its levelling enemies, so he laboured to guard it against the other extreme of popish superstition, with which it was threatened during the short and inglorious reign of James II.—preaching against that system in the warmest manner; and attacking, with equal courage and ability, those false and pernicious dogmas, by which it directly tends to degrade the human understanding, and to corrupt the human character. Some time after the Revolution, he was put into the commission of the peace. In this secular office he remained almost constantly till he became a bishop. During all the time that he held it, he was indefatigable in his endeavours to put down profaneness and immorality, by executing the laws of the land with prudence and vigour. While rector of Avening, he published his *Judicium Ecclesiæ Catholicæ*, &c. It was intended to be a supplement to the *Defensio Fidei Nicenæ*, and to vindicate the *Anathema*, as the other work vindicated the *Faith*, which had been decreed by the council of Nice. For this publication he received the thanks and congratulations of the whole clergy of France, communicated in a letter from the bishop of Meaux. The last treatise which Dr Bull wrote, was his *Primitiva et Apostolica Traditio*, &c. the great object of which was to shew, in opposition to Daniel Zwicker and his apostles, that Christ's existence before the creation of the world was an apostolical tradition, introduced into the first Christian churches, and not a doctrine that was afterwards broached by heretics, or borrowed from the heathen theology. In the seventy-first year of his age he was nominated to the bishopric of St David's, which, however, he accepted of with considerable reluctance and hesitation, on account of his advanced period of life, and indifferent state of health. He was present in the House of Lords when the bill passed for the union of the two kingdoms; and, on that occasion, delivered a short speech, in seconding a motion which had been made, to give a character of the Church of England, as the Scottish parliament had given of *their* church. As a bishop, he conducted himself with becoming zeal, and discharged the episcopal functions with all the care and attention he could bestow. He was particularly strict in examining the qualifications of candidates for the ministry. He shewed great anxiety to promote education among the poor, by the erection of charity schools. He laboured to establish and to encourage family-devotion, and family-libraries, consisting of books on practical divinity. And, while he endeavoured to revive the spirit and the practice of ancient discipline, he also addressed himself to the civil power, for the exercise of its legal and coercive authority against impiety and vice. His intense application to study had impaired his health and constitution; and he had not enjoyed his bishopric above four years, when he was carried off (1710) by a severe distemper, leaving behind him an acknowledged reputation for sound talents, great learning, fervent piety, unblemished integrity, and warm active benevolence. Several years before his death, his Latin works were collected and printed in one volume folio, under the inspection of Dr Grabe; the author himself being prevented by infirmity from managing the publication. After his death, several productions from the bishop's pen were given to the public. Of these posthumous works, his sermons are of the greatest value. They contain much curious matter, and much ingenious discussion, and deserve a careful though cautious perusal from every student of theology. The whole works of bishop Bull have been published together in folio, by his biographer Mr Nelson. See Nelson's *Life of Dr G. Bull*; and *Biographia Britannica*. (T)

BULL, from *bulla*, a seal, is a decree issued by the pope, which is used both in affairs of justice and of grace, and answers to the edicts of secular princes. It is written on parchment, in an old Gothic letter, and has a leaden seal attached to it, which presents, on one side, the figures of Peter and Paul, with a cross in the centre, and on the reverse the name of the pope, with the year of his pontificate. If the bull be a letter of grace, the seal is suspended by silken threads; but if it be a letter of justice, the seal is hung by a hempen cord. According to the laws of the Romish church, no benefices under twenty-four ducats per annum can be granted, and no jubilee celebrated without a papal bull. The bull *in cæna Domini*, which is read every year in the pope's presence on Maunday Thursday, contains violent execrations against heretics, and all who shall disturb the peace of the church; and the thunder of its anathemas is represented by the pontiff throwing a burning torch upon the ground. Upon the death of a pope, his name is immediately erased from the seal, when it is wrapped up in linen cloth, sealed with the seal of the vice-chancellor, and delivered to the chamberlain, to be preserved until a successor be appointed.

This appellation, however, was not confined to the decrees of the pope, but seems to have been also extended to the statutes of some of the emperors. The famous *golden bull*, which is an edict made by the Emperor Charles IV. in 1356, is well known as the *magna charta*, or fundamental law of the German empire. It contains thirty articles, which fix the number of electors, and regulate their particular rights and privileges. The seal is of gold, and exhibits on the one side a figure of Charles IV. seated on a throne, with a kind of gate on the reverse, inscribed "Aurea Romana;" and on the exergue "Carolus IV. Rom. Imp. semper Augustus, Rex Bohemiæ." Another edict, published by the same emperor in 1359, is called the *Caroline* Bull, and cancels all the regulations which had been made by himself or his predecessors to the prejudice of the clergy. (L)

BULL-FIGHTS, a species of entertainment to which the Spaniards are passionately addicted, and which may be termed the *national* spectacle in Spain, as the combats of gladiators were in Rome, and as horse-racing is in England.

The Spaniards seem to have borrowed this amusement from the Moors, by whom it was probably adopted as a substitute for the entertainments of the Roman amphitheatre. We have no reason, indeed, to believe, that the Romans ever introduced bulls on the arena, previous to the bull-fight, which Muratori has described as exhibited in the Colisæum, in 1332, after the fashion of the Moors and Spaniards. But the source of that pleasure, which the Roman and Spanish amphitheatres afforded, was exactly the same; in both, the strength and fury of formidable animals was opposed by the address and courage of human combatants; and the Moors, who had not the same facilities as the Romans for procuring tygers and lions, found a natural and nearly adequate compensation in the ferocity and spirit of the bull.

Whether or not the Romans ever amused themselves with bull-fighting, we are certain that it was not unknown to the Greeks. Festivals, called *ταυροκαθαψιων ημεραι*, or days of bull combating, were held by the Thessalians in particular, at least three hundred years before the Christian era. The city of Larissa was much celebrated for these fights, in which its inhabitants were the most skilful combatants. Among the Greeks, however, these entertainments differed considerably from the bull-feasts of the Spaniards. Several bulls being turned out at once, an equal number of horsemen encountered them with a particular kind of spear. Each horseman opposed himself to one bull, and riding by his side, pressed and avoided him by turns. This parrying was continued till the strength of the animal was exhausted, when his antagonist seized him by the horns, and, without dismounting, threw him to the ground. Sometimes an expert combatant threw himself upon the bull, while yet foaming with rage, and in spite of all the efforts of the animal to dismount him, struck him to the ground amidst the tumultuous plaudits of a vast concourse of spectators.

The bull-fights are conducted in Spain with great pomp and magnificence. In the principal towns, there are large amphitheatres appropriated to these barbarous exhibitions. The amphitheatre of Madrid is three hundred and thirty feet in diameter; the arena two hundred and twenty-five, and it is said to contain fifteen thousand spectators. In some towns where there is no regular amphitheatre, the principal square was converted into a temporary one for the purpose; and the balconies of the different stories were continued across the ends of the streets which terminated in the square.

The exhibition commenced with a procession round the arena or square, in which the champions, who were to attack the bull either on foot or horseback, first made their appearance; and after these came two alguazils on horseback, dressed in wigs and black robes. They advance with solemn step towards the president of the feast, to receive his order to begin. The signal being given, two folding doors fly open, and the bull rushes furiously into the arena; but startled at the sight of the multitude, and stunned by their shouts of joy, he pauses, and looks round as if to single out some proper object for his rage. A picadore, dressed in the old Spanish garb, advances towards him, mounted on horseback, and armed with a long and heavy lance. The two antagonists, as they approach, survey each other with fixed attention, alternately stop and advance, hesitating apparently which of them should begin the attack; till the bull, roused to the highest pitch of fury, stoops with his head, shuts his eyes, and rushes with impetuosity on his adversary. His courage is applauded with renewed clamours of joy; which, while they inflame him with fiercer rage, excite a kind of emulation in the breast of his antagonist. The picadore, fixing himself firmly in his seat, and holding his lance under his right arm, plunges it into the neck of the furious animal, and thus endeavours to push him aside. Maddened with the pain, the bull now wreaks his vengeance on the innocent and defenceless horse which bears his enemy, and generally overturns both him and his rider. This is the most animated, but to a stranger the most disgusting part of the combat. The patience and spirit of the horses, though truly astonishing, are of little avail against the armed fury of the bull. Sometimes the two animals rear themselves together on their hind legs, pushing against each other, the lance of the picadore being fixed all the time in the bull's neck: but as the superior weight of this animal always prevails, the horse has no safety but in flight, nor can he often escape the swiftness of his pursuer. The same bull not unfrequently gores seven or eight horses, which present, before they die, a spectacle, no less wonderful, than it is shocking. With their entrails hanging to the ground from their lacerated sides, they still obey the hand of their rider, directing them towards the bull, from which they have received their mortal wound.

When the picadore, dismounted by his furious antagonist, is in danger of being torn to pieces, the *chulos*, or foot combatants, instantly spring to his rescue, and provoking the animal by shaking before him little banners, or cloaks, of different colours, allow the horseman time to retire. But in saving their companion they expose themselves to equal peril: the bull pursues them with amazing impetuosity; and if they cannot deceive him by dropping the banner which they hold in their hand, their only resource is to leap over the barrier which forms the interior of the circle; and which, though six feet high, is sometimes cleared at the same moment by the torreador and his adversary. As soon as the picadore has recovered himself, and has mounted a fresh horse, he again presents himself before the bull, and the combat is renewed in the same manner as before; or if he has been disabled by his wounds, he is succeeded by another champion, who, approaching with caution, and dextrously avoiding the animal's thrusts, waits an opportunity of striking an effectual wound.

At length, when the poor animal begins to stagger through loss of blood, and its rage increases as its strength is diminished, a signal is given for the horseman to retire, and he is resigned to the *banderilleros*, or foot combatants, who torment him with a more refined species of cruelty. The office of these banderilleros seems to require much greater address than that of the horseman. They are active young men, generally eight in number, each armed with a bundle of *banderillas*, or little arrows, barbed like a fish-hook, and ornamented with streamers of stained paper. These they fix in the neck of the bull, never attacking him, however, from behind, but meeting him in front. By the pain which the arrows inflict, his fury is redoubled; the amphitheatre is shaken by his roaring; and his torture is rendered more acute by his vain efforts to dislodge the weapons which gall him. A fine opportunity is now afforded to his antagonists for displaying their activity and address. When he has singled out one object of vengeance, and is preparing to pierce him with his horns, at the very moment when he pauses and shuts his eyes, his opponent fixes his banderillas and escapes. If he hesitates, and seems afraid to make the attack, they present their *moleta*, or little banner, which they always carry in their left hand, and provoking him to push at that, pass by him in security. He frequently, however, turns quick upon his assailants, and then their only safety is in flight. To amuse him, they let fall their moleta, on which he sometimes spends his fury, trampling it under his feet; but as frequently he keeps his eye fixed on the man who dropt it, and pursues him with such velocity, that he has scarcely time to leap over the fence before he is overtaken by his irritated pursuer, whose wrath, on these occasions, is deadly.

When he has endured these varied torments, till he is almost exhausted, the president gives the signal for his death, which is announced by the sound of drums and trumpets. This is by far the most interesting part of the scene, and affords a subject which an able painter might not disdain to delineate. The *matador* appears alone in the circle, holding in one hand a long two-edged sword, in the other a kind of flag, which he waves before his adversary. The animal sometimes remains immoveable, pawing the ground, lashing his sides with his tail, and seeming to meditate vengeance. His antagonist advances towards him with extreme caution, carefully studying his character, and watching all his motions. A kind of awful suspense prevails throughout the assembly, and anxiety is painted on every countenance, till the matador raises his sword, and aims the fatal blow. If he succeed in penetrating to the spinal marrow, the animal instantly falls, and loud and reiterated exclamations celebrate the triumph of the conqueror. But if the bull survives the blow, he instantly becomes the assailant; and the matador, disconcerted by the hisses and murmurs of the crowd, is not always able to escape from his fury. It is recorded of a matador, named Pepillo, who was uncommonly active and cool, that when pursued close to the barrier, at the instant when the animal had closed his eyes to toss him, he put his foot between the horns, and with this borrowed motion cleared the fence, and alighted upon his feet. In his eagerness to recover his character, the matador sometimes rushes on with a headlong fury, which makes the spectators tremble for his safety. Even the most experienced and active matador may happen to fail in reaching, at the first blow, the vital part. Costillario, whose dexterity is still celebrated in Spain, one day missed his aim, and the bull received him on his horns, and tossed him twice before he could be delivered. He was not much hurt; but his honour had received a stain, till on measuring the horns after the animal was slain, he showed the spectators that the horn by which he had suffered was two inches longer than the other; and upon this discovery, the murmurs and hisses which his failure had occasioned, were succeeded by tumults of applause.

When the poor victim has fallen at the feet of the matador, the trumpet sounds, and three mules drag him off the stage to make way for his successor. These barbarous spectacles were exhibited every week during summer, and frequently twice in the week; and on every day of entertainment, six bulls were sacrificed in the morning, and twelve in the evening. The combatants of each were announced in previous advertisements, as among us the different performers in a play. The three last of the bulls to be slain were exclusively left to the matador, who employed all his skill to vary the pleasures of the spectators. The last bull was particularly devoted to the entertainment of the crowd, and his torments were greater than those of any of his predecessors. The points of his horns were covered with a round case; he is then called *embolado;* and in this state he loses the power of lacerating his tormentors. The spectators then rush in crowds to the arena; and each exercises his ingenuity in torturing the poor animal, which, notwithstanding the sheathes on his horns, makes them sometimes expiate their cruelties by violent contusions. To a stranger, the apparently uniform barbarity of these scenes becomes extremely disgusting; but connoisseurs, who have studied the characters of the bulls, as well as the different methods of alluring, deceiving, and tormenting them, find no one combat exactly similar to another, and pity ignorant and superficial observers, who cannot distinguish their variety.

It sometimes happens that the bulls, either destitute of spirit, or startled at the view of so many human beings, decline the combat, and fly from their persecutors around the arena. Murmurs and hissings then resound throughout the theatre; and the unhappy animal, regarded as a common enemy, is loaded with blows and execrations by all within whose reach he passes. If all their teazing cannot provoke him to rage, there is a general cry of *los perros*, *los perros*, "the dogs, the dogs." Large bull dogs, even fiercer than those of England, are then let loose upon him; and seizing him by the neck, the ears, or the nostrils, pin him to the ground, till the matador kills him by striking a small dagger into his spine.

The expense of these bull-fights is enormous, but is well compensated by the profits which they return. From documents of the first authority, Mr Townshend has calculated the daily expense of these savage exhibitions at 336*l.* sterling; and the daily receipts which they bring at 700*l.* After deducting the salaries of the different combatants, the balance was bestowed to charitable or pious institutions: at Madrid, it formed the principal fund for the support of the general hospital.

The passion of the Spaniards for this horrid amusement was altogether astonishing. Every where, even in the smallest villages, there were places appropriated to the purpose; and when a bull-fight was announced, it excited a more lively joy than would probably have been occasioned by the greatest national benefit. The shop, the work-room, the plough, every domestic and public occupation was deserted for the amphitheatre: people of all ranks and conditions were equally eager for the show, and every countenance was animated with joyful expectation. Even the ladies were not exempted from the general enthusiasm: they discussed the different merits of the picadors, toreadors, and matadors, with as much keenness as our ladies would the gracefulness of a dancer, or the talents of a comedian; and feasted with scenes of blood those eyes, which were intended to be exercised only in softer cruelties. The combatants themselves naturally entertained a high idea of the excellency of their art, and were as vain of their triumphs over their brute antagonist, as a general could be of the most splendid victories over a foreign enemy. Attempts were even made to reduce their important art to a science; and one of their latest and most celebrated champions obliged his countrymen with a book upon the subject.

In vindication of this barbarous amusement, it has been alleged, that it had a powerful tendency to preserve the energy of the national character; and could energy be identified with ferocity, perhaps this defence might be so far admitted. Like the combats of gladiators, this amusement probably owed its origin to the warlike spirit of its inventors; and, if the bulls, instead of being encountered by hirelings, were combated by any champion who chose to display his prowess, valour and intrepidity might thus be rendered, through the influence of emulation, the characteristic qualities of the community. But the cool survey of deeds of cruelty, without any sense of personal danger, or any excitement of the active powers, may indeed harden the heart, and repress all the generous feelings of our nature, but can never induce habits of fortitude and resolution: they may render us ferocious, but will never render us brave. The Roman amphitheatres were never frequented with greater enthusiasm, nor were their arenas ever drenched more profusely with blood, than when that degenerate people trembled at the slightest alarm of a foreign enemy, while their savage dispositions were displayed in plots, assassinations, and civil turmoils: and, whatever compliments polite travellers have been disposed to pay to the softness and elegance of Spanish manners, it is impossible to forget how much the Spaniards are addicted to the use of the stiletto: it is impossible not to trace, in their enthusiasm for bull-fighting, the same cruel but dastardly temper, which delighted in the tortures of the mild and defenceless natives of America.

Formerly, bull-fights formed part of the entertainments which the court gave at certain times for the amusement of the populace. On these occasions, the king and his family honoured the spectacle with their presence. His military household presided to keep order; his halberdiers formed the inner circle of the theatre, and their long weapons were the only barrier they opposed to the assaults of the bull. A more enlightened policy induced the Spanish government to suppress, a few years ago, this kind of amusement, which was productive only of evil; which suspended the exertions of regular industry, and tended to "destroy the two species of animals most useful to man, the horse and the ox, in a country where the latter is not plentiful, and where the better kinds of the former begin to grow very scarce." See Burgoanne's *Present State of Spain*, vol. ii. p. 148—164; Twiss's *Travels in Spain*, p. 287—299; Townshend's *Journey through Spain*, vol. i. p. 342, &c.; and Laborde's *View of Spain*, vol. v. p. 328. (*k*)

BULLIALDUS, Bouillaud, or rather Boulliaud, Ismael, a celebrated French astronomer, was born at Loudun, in the department of Vienne, on the 28th September 1605. After having gone through a course of philosophy at Paris, and a course of civil law at Poitiers, he travelled into Holland, Italy, Germany, Poland, and the Levant, and established a correspondence with the most distinguished philophers of the times. The attention which he had paid to mathematics, civil law, theology, and sacred and prophane history, obtained for him the reputation of an universal genius—a title by no means ill applied, when we consider the great variety of subjects upon which he wrote. Although Bullialdus was born and educated in the Protestant faith, he became a Catholic priest in the year 1639, at the age of 27. After an active life, during which he made numerous astronomical observations, he retired to the abbey of St Victor at Paris, in 1689; and he died there on the 25th November 1694, in the 89th year of his age.

In the year 1638, Bullialdus published at Amsterdam an astronomical dissertation, entitled, *Philolaus, sive de vero sistemate mundi.* This work was republished in 1645, under the title of *Astronomia Philolaica*—a work founded on the hyotheses of the earth's motion round the sun. In this valuable work, which obtained a high reputation for its author, Bullialdus shews, that the inequalities of the planets may be represented, by supposing them to move uniformly in an ellipse round one of its foci, and that the calculation of these is very simple, by imagining a circle and an epicycle, in place of the elliptical orbit. Our countryman, Seth Ward, Bishop of Salisbury, published, in 1656, his *Astronomia Geometrica*, in which he has given a very simple method of calculating the equation of a planet in an elliptical orbit. Hence, the elliptic hypothesis which we owe to Bullialdus, has been called Ward's hypothesis.[*] Dr Ward supposed, that the motion of each planet is so tempered about the focus in which the sun is not placed, as to form at it angles proportional to the times; while Bullialdus makes every planet move in an ellipse, formed by the section of a cone, whose axis passes through one of the foci of the ellipse, and makes the motion of the planet about the cone, and in circles parallel to the base of the cone, to be equal. Hence he supposes, what is just the hypothesis of Ward, that the angles at the focus in which the sun is not, are proportional to the times. Dr Ward has pointed this out in his work, entitled, *In Ismaeli Bullialdi Astronomiæ Inquisitio*, 1653; and has also mentioned several mistakes of our author. These mistakes, Bullialdus has very ingenuously confessed, in his reply to the learned Bishop, entitled, *Astronomiæ Philolaicæ fundamenta clarius explicata et asserta adversus Zethi Wardi impugnationem;* but he has, at the same time, pointed out a very ingenious correction of the elliptic hypothesis. "This correction," says Dr David Gregory, "is well enough, if it be taken only for a correction of the approximation to the true system, as it ought to be; because, by it, the coequated anomaly at length might be found from the mean, *a priori*, and, at the same time, the calculation satisfy observation, which no one had done before him, (according to Mercator's judgment) in the elliptic hypothesis. But when Bullialdus puts it upon us as the true and genuine system, and derives the physical causes of it, after his manner, from the cone, he not only leaves the foundations of his Philolaic astronomy unexplained, but disputes as if there were no physical foundations of astronomy at all."

In 1638, Bullialdus published a work, entitled, *De Natura Lucis.* In 1644, he published his translation of Theo, the Platonist of Smyrna. His treatise *De Lineis Spiralibus Exercitatio Geometrica et Astronomica*, appeared at Paris in 1657. In 1663, he pulished a treatise of Ptolemy's *De judicandi facultate.* In 1666 appeared his *Monita duo ad astronomos; primum de stella Ceti, alterum de Nebulosa in Andromedæ cinguli parte borea, ante biennium iterum orta.* He supposes that the changeable star in the Whale has a part of its surface obscure, and a rotatory motion about its axis: the best hypothesis which has yet been employed to explain these singular phenomana. In 1682, he published his *Opus Novum ad Arithmeticam infinitorum*, fol. Paris. Bullialdus wrote also some pieces concerning ecclesiastical rights; and he published the History of Ducas in the original Greek, with a latin version, and notes. It was printed at the Louvre in 1649. The manuscripts of Bullialdus were preserved in the king's library, and there was also a copy of them in the depot of the Marine. See Perrault's *Hommes Illustres*, Paris, 1697; Niceron *Memoires des Hommes Illustres;* and the *Journal des Sçavans*, Feb. 7, 1675. (*o*)

BULLION.

The question that has of late engaged so large a portion of public solicitude, will lead to a division of this article into two parts of very unequal extent: the first treating literally of *Bullion*,—the second of the *Bullion controversy.* The latter is entitled to a place in a permanent work, both from its present importance, and from its probable connection with future improvements in the state of our money system. It is justly remarked, that ameliorations of the most obvious character, in general, escape attention until forced on mankind by necessity. The rapid fall in the value of money since 1793, and more particularly within these three or four years, appears to us calculated to rouse the attention of the public to the adoption of a different standard, in the adjustment of contracts of long duration. It is long since Dr Smith told us, that money, as a measure of value, was chiefly useful from year to year; and, in this northern part of the kingdom, we have recently seen, in the case of the clerical stipends, the enactment of an optional reference to the current prices of corn. Much time may elapse before the adoption of a correspondent rule in the other important transactions which call for it,—the present season of war and political agitation being highly unfavourable to discussions which demand so much length of deliberation; but it is always one advance towards improvement, to ascertain the origin of past errors. With this view, an enquiry into the causes of the late rise in the price of bullion, may be made the channel of considerable instruction to us.

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[*] Albert Curtius is supposed by some to have first suggested the elliptical hypothesis

I. Bullion may be defined, "Gold or silver in an uncoined and unwrought state." Though the quality of bullion in our markets is understood to be of the British standard, the word bullion is of general import, and may be applied to gold and silver, with whatever mixture of alloy. It signifies also these metals in their unalloyed or virgin state; though they are, in that case, so soft as to be little fitted to receive any permanent shape, and of course are seldom exposed to sale. Our laws, which prohibit strictly the export of British coin, lay no restraint on the traffic in foreign coin or bullion. After oath has been made before the magistrates, that the specie in question has not been obtained from the melting of British coin, the export may freely take place. Gold being with us the standard metal, the word bullion, when used by itself, is understood of gold bullion. The proportions in a pound of gold of the British standard, are 11 oz. 2 dwt. pure metal, and 18 dwt. alloy. The standard weight of our guinea is 5 dwt. $9\frac{3}{5}$ grains; but the more ordinary weight, after a coinage has been in wear, is 5 dwt. 8 grains. A guinea below 5 dwt. 8 grains is no longer a legal tender, nor is there any penalty in melting and using it for the purposes of manufacture. It cannot, however, be exported. The standard price of gold is 3*l.* 17*s.* $10\frac{1}{2}$*d.* an oz.; the standard price of silver is 5*s.* 2*d.* an oz. The relative value of gold to silver is somewht different in different currencies. In ours it is (according to Dr Kelly) as $15\frac{13}{62}$ to 1; in Paris $15\frac{2}{10}$ to 1, which is very nearly the same; in the United States it is about 15 to 1; in Hamburgh 14.7, and in Amsterdam 14.8 to 1.

Until a century ago, silver was the standard metal in our currency, as it still is in the currencies of Holland and Hamburgh. Since 1717, gold has been our standard. Gold bullion in our markets was, during many years, at a very slight variation from the coinage price, with the exception of an interval previous to the great recoinage in 1773, when the worn and degraded state of our guineas made uncoined gold comparatively high. It rose, however, no higher than 4*l.* or 4*l.* 1*s.* per oz., and fell to its proper level as soon as our coin was renewed. But in silver it has unluckily happened, during more than a century, that the market price has exceeded the coinage value of 5*s.* 2*d.* an oz. Hence a powerful temptation to melt the coin; and hence the cause of the sudden disappearance of the expensive coinage executed in king William's reign.

India and China, which used for ages to receive large supplies of silver from Europe, have of late years drawn them direct from America; one result, among others, of the extended traffic of the United States. It happens indeed, oddly enough, that in consequence of the high price of bullion in England, our mint is now at work on silver imported from Bengal. The partial diminution which has taken place in the present age, in the relative value of silver to gold, is to be accounted for by the difference in the quantities respectively produced at the American mines, where gold has hardly kept up its former amount, (*Evidence, Bullion Committee*, p. 129,) the supply of silver has been nearly doubled. Mexico is in this, as in other respects, by far the foremost of the Spanish colonies, the yearly produce of her silver mines appearing now to amount to nearly five millions sterling. The collective produce of the rest of Spanish America in silver and gold, may be estimated at three millions more. Adding to these somewhat less than a million sterling for the produce of Portuguese America in both metals, and somewhat more than another million for the mines of our own hemisphere, we make a total of ten millions sterling annually, added to the stock of the precious metals throughout the world. When we thus find that the produce of the mines of the old world form a tenth part only of those of the new, we need hardly wonder at the rapid decrease in the value of the precious metals which took place throughout Europe in the sixteenth century, the time when the Spanish American mines began to be effectually wrought. A much greater fall would have ensued, had not the extended commerce to India and China opened, chiefly through the medium of the Dutch, a wide vent for these metallic treasures. It appears, from tables in the *Appendix to the Bullion Report*, p. 185, that the relative weight of gold annually produced is to that of silver as one to fifty-two; its relative value as one to three and a half. Spain being the country in Europe which is supposed to feel the effect of depreciation in the first instance, the state of her corn markets becomes an object of consideration. In observing the course of prices in them during the century from 1675 to 1765, we find very little appearance of enhancement; a circumstance which serves to confirm Dr. Smith's opinion, that during that period there was no material rise in the money price of commodities, while, on coming to a later epoch, from 1765 to 1787, the enhancement that took place in the Spanish corn markets, (*Appendix to Bullion Report*, p. 183,) will be found to bear a close resemblance to what happened in our own.

II. We now come to the second division of our article, we mean the question that is still pending, in regard to the resumption of cash payments by the Bank of England. We may look back to the history of parliamentary proceedings for ages, without being enabled to find a topic which has excited a larger share of public interest, or more ample contributions of individual exertion, both in and out of parliament; contributions creditable, on the whole, to their authors, though often marked by the erroneous conclusions inseparable from the application of a limited experience to the discussion of a wide and complicated subject.

Among the various inconveniences produced by our eager participation in the war of the French Revolution, one of the most considerable was the overthrow of our exchanges. That this was not immediately perceptible in 1793, must have been owing to the circumstance of our aid consisting not in money but in troops, and to the large proportion of military stores transported from England. Next summer, the commencement of the Prussian subsidy caused a temporary depression of the exchange, which ceased to exist as soon as it became known, that the infidelity of that power to its engagements would lead to a suspension of our remittances. Besides, Holland and all the north of Germany being open to our merchants during 1794, the counteracting power of commerce had full play in affording a corrective to those encroachments which public expences abroad never fail to make in the natural level of exchange. But in 1795, the case became very different. Our troops had been withdrawn, and our contribution to the continental struggle consisted wholly in money. Holland was no longer open to our commerce, and, what was unfortunately of much more consequence, a deficiency in our harvest forced us to make larger importations of corn from the north of Europe. The balance of commercial payments came thus to be added to the balance of political payments, and their conjunct effect was, a considerable reduction of the exchange. Of the distressing consequences of this state of things, both to our merchants and to government, those only can judge who knew the pecuniary straits of 1795 and 1796, or who have read, in the reports of our parliamentary committees, the anxious conferences and correspondence between Mr Pitt and the Bank directors. It was then (November 1795) that the directors declared that gold had risen in the market eight per cent. above its coinage value, and that Mr Pitt found it necessary to make a promise (which has since been much talked about) of entering into no political engagement likely to affect the state of our circulating medium, without a previous communication to the bank directors. This expression on the part of the minister, which has since been urged as an evidence of the undue influence of the bank, is merely an example of the difficulties in which governments involve themselves, by aiming at exertions beyond their means. Gladly would the bank have been relieved from that connection with government which led to such conferences, but ministers were sanguine in the cause of Austria, and repeated one demand on the bank after another, with all the confidence which marks the feelings of men unacquainted with the practice of business, and the limited resources of commercial establishments. A better harvest in 1796 had delivered us from one source of embarrassment, and was restoring the exchange; but, towards the end of the year, the threatened invasion from France created an alarm which more than counterbalanced this partial relief.

The failure of some country banks having unluckily taken place at this critical period, a run on other country banks, and a drain of gold from the bank of England, was the consequence. It was in vain that the directors resorted to the expedient which, in ordinary times, they had always found to answer,—a reduction of the quantity of their notes. The evil was of a new and peculiar kind, and the drain continued to go on. At last, after diminishing their circulation to nearly eight millions and a half, the directors, finding their demand for cash unabated, communicated to ministers the exhausted state of their coffers; and the consequence was, an injunction from the privy council to suspend all further payments in specie. This suspension was first notified to the public on Monday, 27th February, accompanied with an intimation, that "the general concerns of the bank were in the most affluent and prosperous situation, and that the directors meant to continue their usual discounts, paying the amount in bank notes." And here it is important to remark, by what gradual steps innovations, at first temporary, became incorporated into our permanent policy. The suspension of cash payments appears to have been intended at first for a few weeks only; it was next prolonged to the end of the current session of parliament, and afterward, to a short time subsequent to the opening of the succeeding session. Nor were the means of resuming cash payments wanting at the last of these periods. Corn had become plentiful among us; and the rapid successes of Bonaparte had at that time, as well as afterwards, cut short the projected duration of our continental subsidies. These circumstances, co-operating with the effect of a contracted currency (a cause which we shall more fully explain under the head Exchange), produced a great rise in the exchange between England and the Continent. Specie flowed in on us exactly as it has lately gone out; and an opportunity was afforded to the bank directors to accumulate such a quantity of bullion as might enable them to fulfil their engagements to the public. A resolution was accordingly taken, at a court of directors, on 26th October, 1797, to the effect that they were able to issue specie in any manner that might be deemed necessary for the accommodation of the public, if the political circumstances of the country do not render it inexpedient; but the directors, deeming it foreign to their province to judge of these points, wish to submit to the wisdom of parliament, whether, as it has been once judged proper to lay a restriction on the payments of the bank in cash, it may or may not be prudent to continue the same. A parliamentary committee being again appointed to report on the state of the bank, and finding that no inconvenience had resulted from the suspension of cash payments, declared that, in consideration of political circumstances, particularly the avowed intention of the enemy to injure our credit, "they were led to think it expedient to continue the restriction now subsisting."

The suspension of cash payments was now considered our settled policy for the remainder of the war. The year 1798 was as prosperous as it is reasonable to expect that a year of war can be: we had a favourable season at home, and exemption from the burden of subsidies abroad. Our naval operations were eminently successful, and our merchant convoys arrived in safety from both east and west. Bank notes were in perfect credit; and, confidence being restored among commercial men, money, as always happens in such a case, became more rapid in circulation, and comparatively plentiful. But the succeeding year presented a very different spectacle: Our government, encouraged by the accession of Russia, and in no small degree by our financial prosperity, to call forth anew the power of the Continent against France, engaged both for the payment of large subsidies, and for the maintenance of a powerful army in Holland. No sooner was the formation of this second coalition known, than the continental exchange began to bear the marks of sudden declension; and, as in 1795, it most unfortunately happened, that the evils of scarcity were added to the pressure of foreign expenditure. A season, at first promising, became extremely unproductive from continued rain, and reduced us to seek a supply from the north of Europe, the quarter to which we had already become largely indebted for military aid. The burden of subsidies was not of very long duration; the caprice of Paul, and the vigour of Bonaparte, concurring to the same end;—producing, in the first place, a diminution in the amount of our payments, and soon after bringing them to a close by a continental pacification. But the visitation of a deficient harvest took place, for the third time, in 1800,—a calamity which raised the price of corn, during that and next year, to an unexampled height. The average price of wheat during these two years was nearly 6*l.* a quarter; and it has been declared in evidence, before a parliamentary committee, that the demand for foreign corn, before it came to a close in 1802, cost this country no less than fifteen millions sterling. Here, then, was a season of severe trial for our paper currency; and it was in the year 1800, that an observing eye could first perceive the effects consequent on the irregularity introduced into our system by the suspension of the convertibility of our paper into cash. The mode in which it took place was this: The fall of the continental exchange in 1799, led, as it always does, to the occurrence of mercantile failures; hence scarcity of money, arising partly from actual exportation, but much more from that obstructed circulation at home which never fails to follow a want of confidence among persons in trade. The mercantile distress of the autumn of this year will be long remembered by those who were then in business in London. In this scene of disquietude and embarrassment, the eyes of the merchant were fixed on the bank. An enlargement of discounts was called for, on account both of the direct aid resulting from an increase of our currency, and the still more considerable relief which would arise from an example of confidence afforded by the bank, the reputed centre of mercantile information. The directors, had they been liable to pay in specie, would have felt the necessity of refusing all applications for an extended issue, and even of contracting their current circulation. The unfavourable exchange would have produced a run on them for guineas, which could have been counteracted only by raising the value of their paper, or, in other words, by contracting its amount. But, exempted as they were from such apprehensions, they deemed themselves at liberty to keep the state of exchange out of consideration, and to go as far, or nearly as far, as they were warranted by the validity of the bills presented for discount. The extended issue consequent on this latitude of rule, while it afforded a large profit to the bank, was productive of great relief to the mercantile body. It stopped the progress of the mischief engendered by the overthrow of the exchange; and, had future circumstances, and the disposition of the bank, led to a gradual contraction of the over-issue, the public might have reaped the benefit of aid in the day of need, without much injury from future retribution. But corporate bodies are almost as slow as individuals in persuading themselves to remove the possession of advantages; the bank felt the profit of increased circulation, and did not clearly see that what was good for them could be bad for the country. The rise of bullion above paper, which had now taken place to the extent of nearly three per cent., although conclusive proof of depreciation in the mind of an attentive observer, was little understood by the public at large, and equally little by the weak ministry who had preceded Mr Pitt. It is fair to add, that the year 1802, in bringing us peace and a favourable harvest, proved by no means an era of termination to mercantile difficulties. The fall in the value of merchandise on the one hand,—the dread of a renewal of war on the other,—the heavy loss sustained by the contractors for the loan,—were all circumstances which led the commercial body to desire a continuance of bank discounts on the enlarged scale. The abrogation of the restriction, though twice expected (1802 and 1803), did not take place; and, on the renewal of war, its continuance was regarded as a matter of course.

It may be useful here to direct our attention to the degree of increase which had taken place in the stock of bank of England notes. In regard to small notes (1*l.* and 2*l.*), nearly three years elapsed after the suspension, before their amount rose to two millions—a circumstance to be attributed to the favourable exchange of 1797, 1798, and part of 1799. But whenever the exchange underwent the serious revolution which we have mentioned, our guineas began to find their way abroad; so that, by the end of 1803, our small-note circulation had risen to four millions. The augmentation of our larger notes had been less considerable, being in the end of 18[illegible], only two millions and a half above the amount of the ordinary currency previous to the suspension. When we consider, that the increase of small notes, however profitable to the bank, formed rather a substitution for guineas than an addition to the mass of our circulating medium, the remaining sum (two and a half millions) appears a moderate augmentation for such years of pecuniary difficulty. To this, however, is to be added the extended issues of country banks, the amount of which had been, for some time, in a state of progressive increase, in consequence of the aid afforded them by the bank of England. That aid was partly direct, in the shape of discounts to the London agents of country banks, and to a much greater degree collateral, by the general diffusion of confidence in paper money. To the two and a half millions of increase in bank of England notes, is therefore to be made an addition, probably larger, for the extension of country bank paper; and if we, moreover, make allowance for a cause of more real than apparent efficacy, we mean those improvements in banking which make the same stock of paper go a much greater way, we shall be disposed to regard the total augmentation of our circulating medium, from 1797 to 1803, as very considerable, and as affording an adequate reason for the partial depreciation which had now taken place.

If we divide the history of the bank, since its suspension, into epochs, the years 1797 and 1798 may be termed a season of tranquillity, while the following years, till the conclusion of peace, must be pronounced to come under a less satisfactory description. The renewal of war may be considered a third era; an era in which the advance of national power and prosperity was retarded by enormous burdens, but in which there was, for several years, little direct pressure on our money system. This happy exemption was owing to a double cause;—relief from continental subsidies, and from the necessity of large importations of foreign corn. The harvest of 1803 was abundant; that of 1804, although partially deficient, led to nothing in the shape of scarcity, and that of 1805, 1806, and 1807, were not, taken all together, below a fair average. In regard to subsidies, we were long unable to stir the continent to arms; and when, in the end of 1805, we had succeeded in our favourite plan of a coalition, the rapid success of Bonaparte saved us, as before, from a prolongation of remittances, at the moment (December) when their magnitude had completely overset the exchange. Our subsequent aid to Prussia and Russia was of an extent to prevent a rise, rather than to occasion a fall of exchange; and a gradual recovery began to take place after the peace of Tilsit. The first five years of the war, therefore, were a period of financial stability; the mercantile world, if not prosperous, was exempt from any great or general disaster; and the bank, of course, from any importunate demands for extended issue. The directors had the prudence to keep their circulation steadily within the limit we have mentioned; and the depreciation of their paper, though continuing always at nearly three per cent. was unperceived by the public. Gold was not lower than four pounds an ounce; but it was little heard of in the market, the bank having become, in a manner, the exclusive purchasers.

We are now to enter on a fourth period in the history of the restriction act, a period altogether different from the tranquil years that preceded it. Until the end of 1807, we had conducted our military operations with a careful reference to our means, and had been hardly led into any kind of warfare calculated to expose to hazard the peculiar nature of our currency. But, at this time, all considerations of a calmer kind gave way to the call for *vigour*, and the stoppage of neutral trade, a measure long called for by some of the London merchants, and long resisted by government, received the sanction of the cabinet. The dull sale of our East India merchandise, the unprofitableness of ship-owning, and the annual sinking of West India property,—misfortunes resulting in part from the defects of our own policy, and more from the pressure of long continued warfare,—were ascribed, by the majority of the suffering parties, to the successful competition of the Americans. Mercantile men, accustomed to form their opinions from first impressions, can hardly be expected to take into view the remote consequences of the measures for which they contend. Ardent in the prosecution of the war, and unconscious that its accumulating burdens sap the foundations of their prosperity, they are much more likely to attribute their disappointments to the intrusive interference of foreigners, than to errors at home. Commercial jealousies have always been keen, and the Americans seem likely to become in our eyes what the Dutch were to our ancestors in the days of Cromwell. Her merchants seem to have persuaded government, that if neutral trade was stopped, the continent must draw its supplies from England; and that we should succeed in smuggling them in defiance of Bonaparte's prohibitory decrees. Hence, among other arrangements, the capture of Heligoland, as a station for contraband trade with the north of Germany. While her merchants calculated that these measures would relieve them of the superabundance of their produce, ministers, disposed to join in this expectation, were perhaps more directly actuated by the popularity attendant on a grand demonstration of energy against the enemy. Such was the origin of our orders in council in November 1807. By a singular coincidence, it happened that, shortly before, we had determined to consider the intercourse of America as injurious to us, Bonaparte had adopted an opposite conclusion; and, under the impression, "that all maritime commerce tolerated on the continent, whether through Americans or others, must turn to the advantage of the British," had intimated to the minister of the United States at Paris his intention to permit no longer the neutrality of his country. Accordingly, his rejoinder to our orders bespoke no disposition to evade their operation, but an impatience to drive America to extremity with us, by denouncing vengeance against any of her ships which might submit to our new regulations. From these angry denunciations on the part of the two great powers of Europe, joined to the embargo adopted by congress (22d December), ensued a complete cessation of intercourse between America and the continent of Europe.

After this explanation of the stoppage of the American continental trade, it remains that we trace its effects on the state of our money system. The illustration will be useful, by conveying an idea of the complicated structure of trade, and of the fallacious nature of first impressions in regard to it. Notwithstanding the attachment to France, and the antipathy to this country, produced by the war, for American independence, the mercantile intercourse, consequent on the peace of 1783, was chiefly carried on with us. Britain alone possessed the capital indispensable to the length of credit required by a newly settled country; and while we obtained the almost total supply of manufactured goods, France and the other parts of the continent have been confined, in their intercourse with the United States, to the sale of their particular articles of produce. Such was the division of American trade twenty-five years ago, and such did it continue, with little variation in proportion, however increased in magnitude, till the issuing of our orders in council. The more the imports into the continent from the United States were augmented by the prolongation of the war, the larger became the exportations of British merchandise to America. More than half the proceeds of the American produce sold on the continent was remitted to London, and appropriated to the purchase of our manufactures. To ascertain with precision the amount of these remittances is no easy matter; but from the official documents laid before congress in 1806, they appeared, for some time back, to be from four to five millions sterling annually, or nearly 100,000*l.* a week. Such was the fund which, as Mr. Baring remarks,* had of late formed the support of our continental exchange. Little did our government, in meditating the suspension of neutral trade, anticipate the wound they were inflicting on our own resources; and little were the bank directors aware of the effect of the American remittances on the exchange, when they forbore to raise their voices in opposition to this favourite measure. The privation of this aid was not immediate; for although the stoppage of American arrivals in the continent took place in February 1808, the sale of goods and remittances to England continued till the autumn of that year. We were then deprived of this ample fund, and the exchange underwent a depression, from which it has not yet recovered.

The next cause of the fall of our foreign exchanges in 1808 was of a very different nature, and consisted in the pecuniary aid contributed by us to rescue Spain and Portugal from Bonaparte's usurpation. This drain, serious from its magnitude, was doubly so from its occurring at a time when, by our measures against neutral trade, we had, in a great degree, stripped ourselves of the means of providing for it. The funds which would otherwise have been supplied from American bills, were now to be furnished by the export of new specie; and it appears by the Appendix to the *Report of the Bullion Committee*, (p. 232.) that no less than two millions and a half were sent to the peninsula, between May and December 1808. The transmission of specie, since its scarcity among ourselves, has necessarily undergone a diminution, and almost total cessation; but the heavy expences of the war continue to destroy the equilibrium of the exchange, notwithstanding the vast quantity of stores sent from this country, and paid for by government in bank notes.

The third cause which has operated in aggravation of this evil, is the same which, in former years, was productive of so much mischief, we mean the inadequacy of our harvests. From the unfortunate prejudice against leases throughout the greater part of England, the improvement of our agriculture has by no means kept pace with the increase of our population. Half a century ago, we produced more corn than we consumed, and were in the habit of exporting a proportion to our neighbours. Exportation gradually ceased, and, in the course of time, was succeeded by such an excess in our wants above our means, that, since the beginning of the present century, we have annually imported, on an average, near a million and a half of quarters of corn, forming a yearly value of 3,700,000*l*., exclusive of occasional supplies from Ireland. Our harvests in 1805, 1806, and 1807, yielded their usual produce; in 1808, there was a small deficiency, succeeded unfortunately by a much greater one in 1809. In that year, as in 1799, a crop, not scanty in itself, was exposed to damage in reaping, by a long continuance of rain. It became necessary, therefore, to have recourse to importation, at a time when, from the causes already mentioned, bullion was at 4*l*. 10*s*. an ounce, and the Hamburgh exchange fifteen per cent. against us. Of the two evils, a farther depression of exchange, or an additional rise in the price of corn, the latter appeared to government the more to be dreaded, and licences were accordingly granted for importation. When we find that the sum paid to foreigners for corn in 1810, amounted, as appears by parliamentary documents, to 7,077,865*l*., we cannot fail to consider this as a great additional cause of the fall of the exchange. The favourable harvest of 1810 came most opportunely to our relief; but the deficiency of that of last year, though only partial, has again reminded us of the necessity of depending on foreign supplies.

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* Pamphlet on the Orders in Council, 3d edition, p. 155

The obstruction to our continental trade, by the enforcement of Bonaparte's prohibitory decrees, which to many appear the great and sole source of the evil, rank only fourth in our catalogue of causes. Serious as these obstructions have now become, their operation has been of much later date than the majority of the public are aware of. Bonaparte felt, at every step, the injury which they created to himself, in revenue as in popularity, and used to connive at their evasion, after having nominally enjoined their execution in the most positive terms. The year 1809, though posterior to his vehement proclamations, was a season of very active intercourse between England and the continent. This intercourse was maintained during the first half of 1810; and it was not until the continued depression of our exchange, and the multitude of our mercantile failures, inspired him with the hope, that a rigorous enforcement of his decrees would complete the measure of our embarrassments, that he began to act up to the letter of his edicts. Accordingly, it was only in the winter of 1810 that seizures of British property were made in the Prussian harbours, and that the ridiculous extreme of burning our goods was resorted to in his own dominions. If we look to the magnitude of our exports to the continent of Europe, down not only to 1810, but to the present date, we shall have reason to be surprised, that they so much exceed the limited calculation, which a sense of the multiplied impediments would lead us to form. Still, however, a trade conducted under such disadvantages of expence and hazard, must be infinitely less productive than if direct and unrestrained. In regard to the exchange, it will be found, when attentively scrutinized, to operate less as an original cause of malady than as a prevention of cure. But free transmission of commodities, which forms the natural remedy to an unequal exchange, is now denied us; and the evil, when once in progress from other reasons, is maintained in all its virulence by the effect of these hostile decrees. Among the minor causes of the fall of exchange, might be enumerated the heavy sums paid for freight to foreign shipmasters, Bonaparte's prohibition of remitting bills to England, and the unusual amount of foreign property (1,010,000*l*.)* sold out of our funds, and remitted to the continent in 1810. But enough has been brought forward to account for the occurrence of this distressing event, and it now remains to explain its effects on the state of our money system.

An unfavourable rate of exchange, implying that money is of more value abroad than at home, forms a limit of bounty on the export of merchandise. A slight inequality is thus in general corrected, without the adoption of any other measure than a partial shipment of goods, the nature and amount of which may be safely left to the vigilance of merchants. On the rise becoming greater, and exceeding the expence of the conveyance of specie, bullion is bought up and exported. A continued and farther advance of the exchange, leads to the exportation of the current coin: a practice which no penalties have been found adequate to prevent. Parting with a portion of our coin, however ungracious an expedient, is, in ordinary times, an infallible one, since it tends to bring down exchange in two ways, by paying a part of our debt, and by enhancing the value of our remaining coin. It was thus that we corrected, in the end of 1795, the inequality of exchange caused by the double burden of subsidies and corn-payments. In the still more serious difficulties of 1799 and 1800, this severe remedy was only partially applied; a proportion of our bullion and coin went abroad, but paper supplying its place, the cure was not radical, and our bank-notes remained at a depreciation. No improvement took place during succeeding years; and it was our misfortune to meet the accumulated demands of 1808 with a deficiency in our coin, and a degradation in our paper. The progress of the evil was consequently rapid, bullion rising 15 per cent. above its coinage value so early as the spring of 1809, (*Lloyd's List*,) and bank-notes falling currently to a discount before the end of the year. All the expedients applicable to such a state of things, export of goods, transmission of bullion, smuggling out of coin, were put in practice by the keen and adventurous classes of society, who make it their business to resort to such means. But their efforts were unavailing; the heavy demands from abroad, and a nonconvertible currency at home, baffled all ordinary corrections. It may be worth while to consider, what would have been the course of things, had a similar revolution in the exchange occurred at a time when the Bank was liable to pay in specie. Whether the sum of evil would have been greater or smaller, its progress and character, there can be no doubt, would have been altogether different. The state of the exchange producing heavy demands on the Bank, for guineas to be melted and exported, that establishment would have forthwith had recourse to the well-known remedy of contracting its issues. The claims of government, however urgent, must have been resisted, and the accommodation of discounts almost wholly withdrawn from trade. The consequences would have been an unavoidable relaxation of our exertions in Spain, a general fall in the value of commodities, an embarrassment almost universal among our traders, leading, in innumerable cases, to a temporary suspension of payments, and in many to bankruptcy. All this would have taken place so early as 1809; the deficient harvest of that year would have aggravated our distress; and a defalcation in the public revenue, similar in its cause to that which has just occurred, but greater in extent, would have been inevitable. Our exchange, however, could hardly have fallen below 10 or 12 per cent.; and the correcting powers of trade, if impeded by Bonaparte, would have experienced no incumbrance from the state of our own currency. Such would have been our situation, had we encountered the whole of our calamity in the outset, and sought for no palliation in the substitution of paper for coin. But as things have been ordered, the substitution of paper has both retarded the approach of the evil, and concealed from us its real character. The exchange had been deranged during eighteen months, before the mercantile embarrassments became serious; the Bank, instead of narrowing, consented to increase its issues; the foreign expences of government underwent no diminution; nor has there been any general fall in the value of commodities. On the other hand, the exchange continues, in this its fourth year of depression, so low as 20 or 25 per cent.; the list of mercantile failures appears to suffer no reduction; and the effect of any measure of relief that may be adopted by government must necessarily be remote. It is difficult, therefore, to pronounce, whether the continued use of paper money has lessened or aggravated the pressure resulting from political and commercial causes; the stroke was less sudden, but the wound is perhaps deeper. It is foreign to our plan to enter into political calculations, but there is one idea too important to be omitted: Had the Bank been subject to cash payments, the ruinous consequences of stopping the American trade must have been so soon perceived, that our orders in council would have speedily been recalled, or, more probably, would never have been issued.

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* Chalmers' *Considerations on Commerce and Bullion*, p. 72.

After this narrative of the progress of our paper currency, it remains for us to direct our attention to the measures proposed to remedy its depression. In February 1810, a Committee of the House of Commons was moved for by Mr Horner, to "enquire into the cause of the high price of gold bullion, and to take into consideration the state of the circulating medium of exchanges." A committee was accordingly named, without much interference, it has been said, on the part of ministers, and was occupied during two months in the examination of evidence. The persons examined were chiefly bullion dealers, merchants, bankers, and bank directors. The leading members in the committee, next to Mr Horner, are understood to have been Mr Huskisson and Mr Henry Thornton. It is the custom, in parliamentary committees, after hearing evidence, to adopt certain resolutions explanatory of the sense of the committee, and of the substance of the report about to be framed. It was only in this stage of the business, we understand, that Mr Perceval began to apprehend a decision contrary to the views of the Bank and of government. Coming personally to the committee, which he had hitherto very little attended, and collecting those of the members whose ideas were coincident with his own, he endeavoured, it is said, to negative the proposition, that bank-paper was understood to be depreciated, but in vain; the majority of the committee having made up their minds to an opposite conclusion. The report accordingly went on; but so complicated was the labour, that, notwithstanding the time already bestowed, and the familiarity of the subject to the gentlemen whose names we have mentioned, above a month was required for its completion. It begins with a statement of the extraordinary rise of bullion in our market, and of the endeavours of the committee to ascertain what cause, in the opinion of mercantile men, had led to this irregularity. To the notion entertained by several witnesses, that it was owing to a rise of gold on the continent, the committee could by no means subscribe. The sudden rise in our foreign exchange formed the next topic of enquiry; and here, as in the other point, the committee differ from the opinions of practical men, the majority of whom attributed it to the foreign expences of government, and to the excess of our imports in 1809 above our exports. Two merchants, however, if they did not go so far as the committee, in declaring a depreciation of our bank-notes, were of opinion, that their non-convertibility into cash had been materially instrumental in preventing a re-establishment of the rate of exchange. The committee, in arguing that a considerable part of the inequality of the exchange must be owing to a fall in our paper currency, enter into a very instructive explanation of the distinction between *real* and *nominal* exchange; but they are less successful in an attempt to calculate the relative amount of our exports and imports for the year 1809.

The third subject of investigation, the enquiry into the rules of the bank in respect to their issues, gave rise to some anxious answers. The bank directors appear to have become by this time suspicious of the intentions of the committee, and fought hard to ward off (*Evidence*, p. 79 and 89.) some of their probing questions. The point on which they were chiefly at variance, was, whether the amount of their issues ought or ought not to be regulated by a reference to the price of bullion, and the condition of the foreign exchange. The committee contend for the affirmative, while the bank assert, that the validity of the bills presented to them for discount, should form almost the only subject of consideration. The bank also oppose the idea, that the irregular state of the exchange is owing, in any degree, to a degradation of their paper; an allegation which leads the committee into a series of arguments, to shew that depreciation has been known to exist in cases where the currency was, like that of the Bank of England, of undoubted character as to ultimate solvency. The early part of the history of the bank of England itself, the case of the Scotch banks in 1763, and the more recent example of the bank of Ireland in 1809, are all adduced in support of this position. The committee then conclude this part of the Report, with a mixture of praise and censure on the bank directors. Their conduct, in not attending to the price of bullion and state of exchange, is said to involve "great practical errors;" while their moderation in "limiting the amount of their issues, is declared to entitle them to a continuance of the confidence so long reposed in them by the public." The fourth and last division of the Bullion Report, regards the progressive increase of our paper currency. After exhibiting a list of the annual quantity of bank of England notes in circulation since 1798, and commenting on the bank advances to government, as well as to the mercantile body for discounts, the committee are led into an enquiry into the circulation of country banks. Here, from the scanuness of materials, the greatest caution was necessary; and from the want of it the committee have fallen into very serious mistakes. They sum up the Report by declaring the existence of an excess in our paper currency; by ascribing this excess to the absence of the salutary check of cash payments; by lamenting the evils attendant on depreciated currency; by dissuading the adoption of any indirect schemes to limit our paper circulation; and by recommending an act of parliament to resume cash payments within the space of two years.

Having thus communicated the substance of the Report, we shall venture to make some observations with regard to its accuracy. Without joining in the popular exclamation, that it is the production of theorists, we are of opinion, that the most correct part of it is the exposition of the principles of money and exchange; and that, in several other points, it is defective, from an unacquaintance, on the part of the framers, with the practice of mercantile business. They have fallen into the current error of imagining, that the obligation of cash payments once withdrawn, it was in the power of the bank to increase, almost *ad libitum*, the extent of their circulation. They appear very inadequately impressed with the power of the public to limit the circulation of bank notes, by withholding applications for discount; a power very happily illustrated by Mr Bosanquet, one of the most ingenious defenders of the bank.* Had the committee been sufficiently aware of this, they would have paused before asserting (*Report*, page 24.) that "the suspension of cash payments had had the effect of committing into the hands of the directors of the bank of England, to be exercised by their *sole discretion*, the important charge of supplying the country with that quantity of circulating medium, which is exactly proportioned to the wants and occasions of the public." Perhaps, also, they would have qualified their encomium on the directors, for their "forbearance in turning their power less to the profit of the bank than it would easily have admitted of." Our next animadversions on the writers of the Bullion Report, regards their inattention to the striking points in the history of our paper currency since the beginning of the war of 1793. No notice is taken of the pecuniary embarrassments of 1795 and 1799; nor is any attempt made to ascertain the causes of the remarkable increase of bank notes subsequently to the latter year. These were not topics of mere curiosity: they bore, as we have endeavoured to shew, a direct resemblance to the unfortunate circumstances of the year 1808. The chain of reasoning supplied by a knowledge of antecedent difficulties, would have led the writers of the Report, by an easy course, to an estimate of the share which our expences in the peninsula, and our importations of corn, have had in our recent difficulties. Perhaps, also, it might have conducted them to a discovery of the evil of a new kind, which we had brought on ourselves, by stopping the American continental trade. To have enumerated, and made allowances for the operation of those powerful causes, would have carried conviction to the minds of the mercantile community, and have disarmed their opponents of their most efficient weapons. Enough would still have remained to substantiate the charge of depreciation, and to justify the argument, that had our paper been convertible into cash, the disorder in the exchange would have been neither so great nor so permanent. But as the Report stands, no notice is taken of the increase of our foreign expenditure in 1808; no reference is made to the deficient harvest of 1809; and the American trade, though alluded to in the evidence of their favourite witnesses, (*Appendix*, p. 78, 130, 131.) is allowed to pass unnoticed by the committee. An acknowledgment, indeed, is made (*Report*, p. 16.) of the influence of political and commercial causes, but it is couched in general terms, and the topic is forthwith exchanged for an argument on the degradation of paper.

We have already mentioned, that the fourth division of the Report, which treats of country banks, is particularly liable to animadversion. Without dwelling on the errors in the attempt to ascertain (p. 29.) the increase of their circulation, we shall confine ourselves to the consideration of a general position, taken from Mr Thornton's book on paper money, and couched (*Report*, p. 28.) in very prepossessing terms. "If an excess of paper be issued in a country district, while the London circulation does not exceed its due proportion, there will be a local rise of prices in that country district, but prices in London will remain as before. Those who have the country paper in their hands, will prefer buying in London where things are cheaper, and will, therefore, return that country paper on the banker who issued it." The error of this argument lies in supposing, that the London market forms a direct check on the country markets, as if the commodities purchased in the one, were not, in general, quite different from those of the other. In the metropolis, imported merchandise forms the great article of sale; in the country towns, the produce of the land, and the local manufactures. The check on the over-issue of paper must arise from very different sources, and will be found to consist fundamentally in the obligation to pay interest; a sacrifice which no man will incur without cause. Another and a more serious fault in this part of the Report, consists in the loose manner in which the great rise in the price of commodities is charged on our paper currency. The committee dwell largely on the magnitude of the evil, without attempting precision in regard to the share which the over-issue of paper may have had in it. From this vague mode of expression, the public are led to infer, that the unfortunate rise of our commodities might have been produced by the conduct of the bank, although neither new taxes nor new corn laws had been in existence. Now we have no hesitation in attributing a part of the rise to over-issue of paper; but, on resorting to the ordeal of close calculation, we find that part much smaller than is generally believed. If to the depreciation of three per cent. which has lasted since 1800, we add six or seven per cent. for the over-issue of the last three years, (and more we cannot think applicable to our home transactions, whatever may be the case as to our foreign,) we set down in all an enhancement of ten per cent. to charge of our paper currency. But the total rise in the price of commodities since the bank suspension of 1797, exceeds, as is well known, sixty per cent., leaving five-sixths of the burden to be otherwise accounted for. In another and a more extended point of view, we should have little difficulty in bringing an additional part of the charge against paper money. War is the great cause of the rise of prices; and the aid of paper money, perhaps the exemption of the bank from cash payments, may be pronounced one of the principal reasons why we are not now at peace. But such is not the meaning of the bullion committee. They make no reference to the rise of prices produced by the *use* of paper money; their business is with the *abuse* of it; and there, we cannot help thinking, they have over-rated the extent of the effect.

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* Bosanquet's *Practical Observations*, page 57.

It would have been desirable also, that the bullion committee, in urging the pernicious effect of our paper currency on the exchange, had more clearly distinguished between non-convertibility and over-issue. In the first and more accurate part of the Report, the non-convertibility of our paper into cash, engages a share of their attention, which seems to be afterwards lost amidst their extraordinary calculations of over-issue. It has unfortunately happened, that several of the writers who have followed on the same side have laid the chief stress on the latter; excess of quantity being, as Mr Burke said of force, one of the apparent means most likely to arrest the belief of superficial inquirers. To these animadversions on the Report, it is proper to add, that it is rather an able exposition of the doctrines of others, than an original work; a remark in which those to whom Dr Smith's book, Henry Thornton's *Inquiry*, and the *Thoughts on the Restriction Bill* by Lord King, are familiar, will have no hesitation in joining. Yet, in spite of all these deductions, the Report of the Bullion Committee is entitled to great consideration. It affords an example of what we have long wanted in this country, the application of the principles of political economy to the practice of trade. It is the fruit of close thinking and wide research, and its errors are chiefly to be ascribed to the singular complexity of a subject, a knowledge of which would appear the task of years rather than of months. If we make allowance for the impressions, in several respects exaggerated, under which it was written, we shall find reason to praise its moderation, particularly when put in contact with the positive and absolute language of other productions. We shall conclude our remarks on it by desiring those to whom this qualified encomium may seem too favourable, to compare it with the hasty statements and meagre reasoning which so often characterize the labours of other parliamentary committees.

If we direct our attention to the principal writers who have appeared on this most fertile of topics, we find in Huskisson a great deal of anxiety to make the public thoroughly acquainted with the merits of the question; in his antagonist Bosanquet, strong evidence of acuteness, unaccompanied, however, by an adequate knowledge of general principles; in Ricardo, accuracy and promptitude in calculation. Among the lesser tracts, Jasper Atkinson's Letter to a Member of Parliament, contains a clear and temperate argument against the Bullion Report; while Wilson's Observations on the Depreciation of our Currency, will remove the doubts of the few who question the impolicy of our corn-laws. In Canning's printed speech, the reader admires more a display of oratory, than a knowledge of the subject; while that of Mr George Johnstone claims attention for polished language, as well as for perspicuous illustration. He who desires to acquire a knowledge of the intricate subject of exchange, will do well to study the publication of Blake; and an instructive example of the causes of a bank stoppage will be found in the official report of Dupont de Nemours on the embarrassments of the *Banque de France* in 1806.

We cannot help thinking, although the remark has no where been made, that had the bank suspension not taken place in the spring of 1797, it would, in all probability, have been unnecessary down to the present day. When the credit of an establishment stands so high, there is no hazard of a run for cash for the purposes of inland trade; the demand can be only for foreign use. Now it so happened, that our great continental subsidies came to a close in 1797, and though thrice renewed since that time, they on no occasion lasted so long as to create embarrassment to the bank. Had we ventured, without the aid of the restriction act, to form the coalition of 1799, the cash, which was at that time abundant in the bank coffers, would have supplied the chief part of the subsidies. This point once adjusted, it is scarcely probable that any considerations arising out of the want of foreign coin, would have induced ministry to resort to the unprecedented and alarming measure of suspending cash payments. If we suppose that critical interval got over, we shall find no combination of circumstances of more recent date, likely to necessitate the adoption of the measure. The war in Portugal, like the war in Flanders of 1793 and 1794, is in a great measure defrayed by the supply of stores from home; the prohibitory decrees of Bonaparte may prevent the recovery of our specie, but could hardly have drained it from us; and in regard to the American continental intercourse, the bank directors would not have failed to oppose the clamour of the ship-owners, and stay the hand of ministers, had the liability to cash payments been in force. It is true that the alarm of invasion was great during the two first years of the present war, but to those who apprehend danger to the bank from such a cause, we would summit two important considerations; first, that those alarms are, in great part, the act of our own government, with the design of keeping us prepared; for, in the beginning of 1797, at the very time when ministers were loudly promulgating danger, Mr Pitt, on finding that it had produced a drain of cash, made this remarkable admission, in his conference with the bank directors (21st February,) that "the alarm was now become much more general than he could think necessary."* The next point is, that the dread of invasion need not, *unless accompanied by an unfavourable exchange*, deter the bank of England from increasing the amount of their circulation. Notes of such high credit would continue to obtain currency for commercial as well as financial purposes, and we have the authority of the *Bullion Report* (p. 27.) for the inference, that, had the bank boldly increased their issues in February 1797, there would have been little danger of a stoppage—an additional proof how near we were to an exemption from that mortifying alternative.

Fallen in some degree, as we must admit our paper money to be, a retrospect of its history, and a comparison with that of our neighbours, will not fail to suggest to us several flattering considerations. In looking to the example of the French republic, and, more recently to those of Austria, Russia, and Sweden, we find their paper currencies doomed, as soon as government interferes, to rapid depreciation. Among us, ten years elapse after so great an irregularity as the stoppage of cash payments, without any farther degradation than three per cent. The source of this comparative superiority will be found in our long established habits of industry, and that promptitude and regularity in our transactions which are its happy consequences. But the more immediate causes have been the productiveness of our taxes, and an independence of government, almost complete, on the part of the bank. Without denying the necessity of partial improvement in the constitution of that corporation, it may be justly said, that they never force a note into circulation, and that the principal additions made to their paper since the suspension, have borne less the character of voluntary emissions than of advances for the relief of trade. Open as some parts of their conduct are to censure, we may safely say, that, with the exception of Holland in its better days, no country in Europe would have afforded an example of a delicate trust discharged with such a share of honour and moderation.

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* Report of the Lords' Committee, 1797

In comparing the price of bullion in our market with the state of our continental exchange, since the commencement of the present depreciation, we find a difference often of eight per cent.; that is, while bullion is fifteen per cent. above coinage value, the exchange with Hamburgh or Holland may be so much as twenty-five per cent. against us. This difference appears to represent the expence and hazard on the conveyance of specie to the continent. In adverting to the parliamentary transactions relative to bank notes, we find that the act of 1797 went no farther than suspending the arrest of the person and goods of a debtor after he had made an offer of payment in bank notes; and even that the act of July 1811, founded on Lord Stanhope's bill, did not go so far as to make bank notes a legal tender, its principal provisions being to impose a penalty on buying or selling them at a discount.

If we refer the practical results of trade to the principles laid down by our illustrious countryman, Dr Smith, we shall generally find reason to admire the soundness of his conclusions. Though partial to the use of paper money under due restrictions, he is yet aware of its comparative instability, and gives his readers cause to be prepared for the recurrence of such embarrassments as those of 1793 and 1795. In regard to the country banks, he apprehends no danger from their multiplication, so long as they are bound to pay their notes in cash, and are restrained from issuing any under five pounds. Such was their situation previous to 1797. When we consider the general prejudices against private banks, it seems not unlikely that their exemption from interruption on the part of government was, in some degree, owing to the weight of Dr Smith's authority. Since 1797, though deprived of their title to his recommendation, they have had but too powerful a hold both on government and the country, in consequence of the public necessities; and that remedy, which brings them back to the observance of former rules, must be slow of operation, and accompanied, we fear, with considerable embarrassment to the public. (*x*)

BUMALDA, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 154.

BUMELIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 136.

BUNDELCUND, a circar of Hindostan, on the south-west side of the Jumnah, in the province of Allahabad. The country is in general mountainous and covered with wood, but the soil in many places produces plenty of cotton and all kinds of fruits, though neither rice nor sugar. This circar is more than 100 miles square. It contains some strong fortresses; and the celebrated diamond mines of Punna afford a considerable revenue to its rajah. Chattespour is reckoned the capital. (*h*)

BUNIAS, a genus of plants of the class Tetradynamia and order Siliculosa. See BOTANY, p. 254.

BUNIUM, a genus of plants of the class Pentandria and order Digynia. See BOTANY, p. 158.

BUNKER'S HILL. See AMERICA, *Index*.

BUNYAN, JOHN, best known as the author of the *Pilgrim's Progress*, was born near Bedford, in the year 1628. His father, though a tinker, gave him a better education than usual, by having him taught to read and write. But being of very froward disposition, and much exposed to the contagion of bad example, he early began to indulge in all manner of vice, and soon became, in every respect, a notorious profligate. During his wicked career, however, he had frequent and strong convictions of guilt. Various circumstances occurred to lead him to serious reflection on his conduct. His imagination was so powerfully impressed, that he thought he heard a voice from heaven warning him of his danger. And the result of all this was a complete and permanent reformation of character. About the year 1655 he became a member of a Baptist society at Bedford; and was so zealous in his religious profession and practices, which stood directly opposed to those of the court, that, after the restoration, he suffered, along with multitudes of his fellow Christians, the severest persecution. Having transgressed the law against conventicles, that is, having chosen to worship God according to the dictates of his own mind, and to maintain, with earnestness, his own views of scripture doctrine, he was indicted, at the instance of the king—stood trial at the Bedford quarter sessions for his alleged offences, and was found guilty of "devilishly and perniciously refusing to go to the established church, and upholding unlawful meetings, to the great disturbance and distraction of the kingdom." His trial was conducted with the characteristic injustice and tyranny of those times. The facts stated in the indictment were not proved. No witnesses were adduced against him. Some words, which accidentally fell from him in conversing with the justices, were taken for a conviction. And these worthy administrators of the acts of Charles II. actuated by the spirit, and obedient to the will of their master, pronounced upon poor John Bunyan a sentence of perpetual banishment. This sentence was not executed, but its victim was cast into prison, and remained there for twelve years and a half, enduring his wrongs with much patience, supporting himself and his family by making tagged laces, and engaging in religious exercises with above sixty dissenters, who were confined in the same place for the same illegalities. He was at length enlarged through the benevolent interference of Dr Barlow, Bishop of Lincoln. During the last year of his imprisonment, (1671) he was unanimously chosen pastor of the congregation at Bedford, to which he belonged. And afterwards taking advantage of James the Second's declaration in favour of liberty of conscience, he built, with the assistance of his followers, a public meeting-house in that city, in which he regularly preached to large and admiring audiences. It is said that Dr John Owen was one of his hearers, and gave countenance in other respects to his ministerial labours. He died in London, on the 31st of August 1688, in the 60th year of his age.

Bunyan laboured under great disadvantages, in point of education and external circumstances; but he seems to have possessed no inconsiderable portion of genius; and had he been more favourably situated, would proba bly have made a greater figure in the world than most of his contemporaries. Of this we have sufficient proof in his *Pilgrim's Progress*, a work which has no equal in popularity, and which is distinguished by many real excellencies, both as a work of poetic fancy and of practical divinity. The allegory is well conceived, and well conducted. It frequently offends by its coarseness and vulgarity, but at the same time excites so much dramatic interest, and gives such lively delineations of real life, as to make the reader overlook these minor defects. The theology which it teaches, is systematic Calvinism: it is Calvinism, however, coming home to the Christian's experience, and producing its moral effects on his heart and conduct. And it is a well-known fact, that few books have done more good among the people than the *Pilgrim's Progress*. Though the merits of the author are universally acknowledged, it is not generally known that he had the model of this work before him in the *Isle of Man, or the Legal Proceedings in Manshire against Sin*, a curious little allegory, written by the Rev. Richard Barnard, and published in the year 1626. Bunyan produced various other pieces of inferior merit. Of these the *Holy War* is in greatest repute among the lower orders, for whom it is, from its style and manner, chiefly intended. A complete edition of his works was published in 1767, in two volumes folio, adorned with copperplates, and accompanied with a recommendatory preface by Mr George Whitfield. See *Grace abounding to the Chief of Sinners, in a faithful account of the Life of Mr John Bunyan*. This is written by himself, and contains a very particular account of the conferences which he had with the judges by whom he was tried, and of the oppressive manner in which he was treated by his persecutors. It is in this, as in several other respects, an excellent picture, both of Bunyan himself, and of the times in which he lived. See also Grainger's *Biograph. Hist. of England; Account of the Life of Bunyan*, prefixed to the above-mentioned edition of his works; and *Biograph. Brit.* (τ)

BUONAROTTI, Michael Angelo. This celebrated person, who has generally been considered as the great restorer of the arts of painting, of sculpture, and of architecture, was born in 1474. The place of his nativity was Castel Caprese, in Tuscany; a fortress of considerable importance in the commonwealth of Florence, of which his father was governor. He is said to have manifested, even in his childhood, a powerful propensity to the arts which afterwards immortalized his name; and when put to school, under the tuition of Francisco d'Urbino, he obstinately persevered in devoting so large a proportion of his time to drawing, that he made little proficiency in his other studies. It was with great reluctance that his father and his other relations consented to his persevering inclinations; and so far sacrificed their own views of family dignity, as to permit him to enter upon the regular study of painting as a profession. At the age of fourteen he became the pupil of Dominico Ghirlandaio, a painter of no inconsiderable merit, when we take into account the false taste which had so generally degraded the art at the period when he began to exert his talents; though, at the same time, it must be admitted, that to the future eminence of those illustrious men who issued from his school, rather than to his own individual success, he is indebted for the place which is assigned to his name in the remembrance of posterity. Michael Angelo alone secures it from the possibility of oblivion.

It has been mentioned, as an honourable testimony of the high expectations which Michael Angelo had already created, that, on entering the school of Ghirlandaio, it was stipulated that his master should pay him an annual salary, although custom had established the contrary practice of paying to the master a considerable premium. It is said, that the jealous temper of Ghirlandaio operated as a frequent bar to the advancement of his pupils; and Condivi has asserted, what cannot be strictly true, that Michael Angelo became so marked an object of his envy, that he derived no benefit whatever from his instructions. To acquire the power of minute imitation, was the great object of his first ambition; and, notwithstanding the deviations from individual nature, which his powerful and poetical mind enabled him at an after period to practise with unexampled boldness and success, it is instructive to know, that, at his outset, perhaps no man ever devoted himself with more unwearied assiduity to the literal and accurate representation of whatever he attempted to paint; nor was it till he had secured actual and real *nature* as his conductor, that he ventured forth into the perilous regions of ideal grandeur and sublimity.

Among the circumstances which, at this remarkable period, conspired to favour the progress of the arts in Italy, while much must be ascribed to the general diffusion of a strong and enlightened relish for them in the public mind, they were peculiarly indebted to the liberal and munificent patronage of the family of Medici. About this time the art of sculpture was supposed to be less understood than that of painting: and it was with a view to its encouragment that Lorenzo de Medici formed an ample collection of statues, busts, and basso-relievos; and free access was afforded to all who were desirous of forming their taste, by studying and drawing from the antique. Of this opportunity Michael Angelo did not fail to avail himself; and though his first intention had only been to improve himself in the knowledge of drawing, he soon became enamoured of the art of sculpture; and the success which attended his first efforts, effectually procured him the marked notice and patronage of Lorenzo. This was the commencement of an intimacy, which was not less advantageous than flattering to Michael Angelo. As yet only about fifteen years of age, he was invited to live in the house of Lorenzo. He was treated as a friend,—he enjoyed the conversation of men of rank and genius,—he was permitted free access to the gems and works of art, which were fitted to improve his taste,—and was accommodated with whatever could contribute to his comfort or to his progress.

The death of Lorenzo, which happened about two years after, was an irreparable loss to the arts. His successor Piero continued, indeed, to afford them that kind and degree of patronage which consisted with the worthlessness of his character and the depravity of his taste. Michael Angelo, who enjoyed a share of his notice and employment, still continued to reside in the palace; and his protector was proud to say, that he had two eminent men under his roof,—a Spanish footman, remarkable for his speed in running, and Michael Angelo. By order of Piero, Michael Angelo executed several works of sculpture; but the disturbances which arose in the state of Florence induced him soon after to retire to Bologna. Here he was received with flattering marks of consideration, and executed two statues for the church of St Dominico.

After his return to Florence, he executed a variety of admirable sculptures, particularly the well-known colossal statue of David, which was placed in front of the Palazzo Vecchio. The statue of Moses, executed at a subsequent period, is generally acknowledged to possess, in a higher degree than any of his other numerous sculptures, that character of majesty which more or less appears in the whole of them.

Whether Michael Angelo excelled most in painting, in sculpture, or in architecture, it would be no easy task to determine. "Of a genius," as is observed by one of his most zealous admirers (M. Fuseli), "who succeeded beyond rivalship in whatever he undertook, it is difficult to fix the principal sphere; but it appears to be incontestible, that however great the loss, in such a case, might have been to either art, painting would have suffered more if deprived of his powers than even sculpture. In sculpture we possess the reliques of the antique,—works that more than rival his. But what is there in painting that could compensate for the loss of the Sistine chapel?"

The pictures which occupy the ceilings of this edifice were finished in the year 1512: and it stands on undoubted evidence, however fabulous it may seem, that the time spent in the execution of this stupendous monument of human genius, did not exceed twenty months. The celebrated picture of the Last Judgment, which fills the façade of the chapel, above the altar, was a subsequent performance, executed during the pontificate of Paul III.; who, soon after his accession, paid a visit to the artist in person, attended by ten cardinals, to solicit him to undertake the work. It was finished in 1541; and, according to Vasari, was accomplished in less than seven years.

In the chapel called the Paulina, from its founder Paul III., Michael Angelo, when advanced in years, was employed to paint the Conversion of St Paul, and the Crucifixion of St Peter. They are generally considered as greatly inferior to the works in the Sistine chapel.

It is commonly said that Michael Angelo entertained a contempt of oil painting, and used to call it the work of women and idlers. Whether he ever practised the art himself is doubtful; the fact at least rests on very slender evidence; as several works of his hand, which were long supposed to be in oil, have recently been discovered to be in distemper, and the picture of David and Goliah in the Louvre is not considered as genuine. According to the opinion of M. Fuseli, it is the work of Sebastian del Piombo.

The church of St Peter's is the splendid monument of Michael Angelo's genius and success as an architect. This fabric was begun by Julius II. in 1506, and entrusted by him to the superintendence of Bramante. After his death, the care of this immense work, was conferred on Antonio de San Gallo. After the work, by the change from one plan to another, had, as it advanced, threatened to turn out a mass of jarring incongruity, it was submitted to the judgment and direction of Michael Angelo, who, notwithstanding its complexity, simplified and harmonized the whole.

To whatever department of art Michael Angelo applied the powers of his mind, he seems from his first outset to have evinced an energy, originality, and sublimity of conception, almost peculiar to himself; and which has led some of his admirers to speak of him as of a being gifted by nature with powers of a superhuman order. Majesty and grandeur are the great characteristics of his style: character and beauty he admitted only as far as they could be made subservient to these more exalted qualities. Considered as a painter, it was his glory to raise the art far above what is included in the mere *imitation* of nature, and to place it on a level with the heroic in poetry. And it seems generally admitted, that the success with which he accomplished this is such as to leave far behind whatever has been attempted with similar views since his time. One of his most enlightened admirers, and most devoted and zealous encomiasts, Sir Joshua Reynolds, denominates him, "the exalted founder and father of modern art; of which, he adds, he was not only the inventor, but which, by the divine energy of his own mind, he carried at once to its highest point of possible perfection." The characters represented by Michael Angelo possess that kind of elevation above common and individual nature, which belongs to the personages of Homer or of Milton. In either case, although nature supply the materials, it is the boast of art to new model and arrange them to the production of something higher and more perfect than real life ever presents to our observation. And no where, perhaps, are there higher examples of the extent to which this may be successfully carried, than are furnished by the works of Michael Angelo. The personification of the Supreme Being, in the centre of the Capella Sestina; the Sybils and the Prophets in the same chapel; are all instances of this, in which the human form and expression are elevated to a character of grandeur and majesty far beyond the pitch of actual nature, as it is any where exhibited to our senses.

It is obvious, that the habits of mind which consist with the power of conceiving and expressing this ideal perfection and grandeur, are of a kind which unavoidably expose those who fearlessly obey their impulse to the hazard of occasional caprice and extravagance. From a charge of this description the most partial admirers of Michael Angelo do not attempt to vindicate him. Habituated as he was to move in a higher region, which disowns those visible landmarks and limitations that effectually guide and restrain the inferior walks of the art, he sometimes seems hurried away by the impulse of an inventive and fruitful mind, which for a time has ventured to trust imagination without its accustomed curb. It is not without reluctance that some of his ablest defenders have been forced to own, that there are figures of his, of which it is difficult to determine whether they are in the highest degree sublime, or in the greatest degree ridiculous. If this reflection have any just application to Michael Angelo, it is doubly applicable to many of those who have since enlisted themselves in the numerous train of his imitators, for whose follies and absurdities it has often been his fate to suffer indiscriminate and unmerited censure.

The colouring which Michael Angelo adopted is the reverse of that which is peculiar to the ornamental style; and whether it would have been an advantage had it possessed more of that splendour which is admired in Titian, is a point which has frequently been disputed.

From his infancy he was distinguished for unwearied diligence, and this was in general continued through his whole life, till old age subdued the vigour of his gigantic faculties. There was one considerable period, indeed, during which these faculties were most shamefully misapplied; and that this loss to himself and to mankind originated in an express command of one whose chief ambition it was to be distinguished as the most magnificent and enlightened patron of the arts, is a reflection calculated only to aggravate that stigma which the unpardonable absurdity of such a transaction affixes to the boasted character of Leo X. During the whole reign of that celebrated pontiff, a period of more than eight years, the chief occupation assigned to Michael Angelo, was to superintend the quarrying of marble amongst the mountains of Pietra Santa, and the formation of a road to convey it to the sea. Nor can it be received as any apology for having ordained this criminal expenditure of divine talents and genius, that Leo X. was, in fact, aware of their excellence; and that the task which he imposed on their possessor, was only intended as introductory to more considerable works of sculpture and of architecture, of which Michael Angelo was afterwards to have the direction.

Michael Angelo died in 1563, at the advanced age of 90 years. He was of the middle stature, of a bony and spare make. His countenance was disfigured by a blow which he received in his youth from his cotemporary sculptor Pietro Torrigiano. (*t*)

BUPHTHALMUM, a genus of plants of the class Syngenesia, and order Polygamia Superflua. See Botany, p. 299.

BUPLEURUM, a genus of plants of the class Pentandria, and order Digynia. See Botany, p. 158.

BURCHARDIA, a genus of plants of the class Hexandria, and order Monogynia. See Brown's *Prodromus Plantarum Novæ Hollandiæ*, &c. p. 272; and Botany, p. 189.

BURFORD, a market-town in Oxfordshire, about 72 miles W. N. W. from London, is situated on a rising ground, near the river Windrush, and is chiefly remarkable as being one of the oldest towns in the Mercian kingdom. Many of the houses are modern built; and the church, which is a spacious and handsome edifice, with a very fine spire, displays some curious specimens of ancient architecture. The south porch is highly decorated; and the entrance on the west is ornamented with birds heads, &c. Burford has a considerable manufactory for rugs and duffels, but it is particularly famous for saddles. Though not a corporate town, it is governed by two bailiffs, and has a common seal. The horse races, which are held on the neighbouring downs, are much frequented by the Oxford students and the surrounding gentry. A field, called Battle-edge, a little west of the town, is shewn as the scene of a dreadful conflict which happened in 752, between Ethelbald, king of Mercia, and Cuthred, king of Wessex, when the former was completely defeated; and a festival is still celebrated by the inhabitants on Midsummer eve, in commemoration of the victory. It has two annual fairs, and a market on Saturday, which is well supplied with cattle and corn. It contains 304 houses, and 1516 inhabitants, of whom 699 were returned in 1801 as employed in trade and manufactures. N. Lat. 51° 50′, E. Long. 1° 38′. (I.)

BURGAGE-TENURE, is a species of holding known to both the English and Scots law, by which a proprietor of lands, houses, or other tenements, within the liberties or incorporated territory of a borough, holds of the king, or other person, under the burden of certain services to the borough, or a fixed rent-charge to the lord. In England, it is considered as a relict of the ancient Saxon liberty, being nothing else than a tenure in socage, the free or *certain* nature of which the lawyers of that country are fond of tracing to those remote times. Hence they account for the variety of customs, not strictly feudal, by which property held under this tenure is affected. Among these the most remarkable seems to be, that known by the name of Borough-*English*, of which we have already given some account. In some English boroughs, too, the widow has right, by privilege of this tenure, to be endowed of the *whole* of her husband's tenements, and not of a *third* only, as at common law. In others, the tenements might have been disposed of by will, previously to the statute of Henry VIII., by which that right was made universal. There are about 29 burgage-tenure boroughs in England, in which the right of voting for burgesses to serve in parliament belongs to every individual proprietor of an house, tenement, or spot of ground on which a house has anciently stood.

With regard to Scotland, it has been doubted whether this species of tenure, properly understood, is peculiar to royal boroughs, or whether it extends in some instances, as in that of Paisley, and perhaps some others, to boroughs of an inferior order. Be this as it may, as, in royal boroughs, the whole community is the king's vassal, in virtue of the original charter of erection, so each individual proprietor holds of the crown, (except where the lands, or other tenements, originally held of a subject, and he had refused his concurrence to the erection,) and must be infeft by the magistrates as the king's bailies. The services exigible are denominated *watching and warding*, the nature of which is sufficiently indicated by the expression. As in England, however, the customs and privileges falling under this kind of holding, are very different in different places, depending partly upon immemorial usage, and partly on the particular constitution or *set* of the borough. But in none of them are the individual proprietors, as in the burgage holding boroughs of England, allowed a direct vote in the election of their representatives in parliament, the highest privilege of that nature enjoyed by any of them being a vote in the election of their magistrates, who, in the case of royal boroughs, appoint the delegates who elect the representative for any particular district of boroughs.—One *dictum* of law, common to all royal boroughs, is, that the widow is entirely excluded from her terce, or third of the rents, of her deceased husband's burgage tenements;—a curious contrast to the usage of some English boroughs, where, as above noticed, custom has fixed the opposite extreme, of endowing the widow in the *whole* of the husband's burgage rents. See *Blackst. Com.* lib. ii. cap. 6.; *Bankt.* and *Ersk. Inst.* &c. (J. B.)

BURGER, Godfrey Augustus, a popular German poet, and well known in this country as the author of the celebrated ballad of *Leonora*, was born at Wolmerswende, in the principality of Halberstadt, on the 1st of January, 1748. In his infancy, as he himself informs us, he displayed no uncommon indications of superior genius; but was, on the contrary, considered by his parents as remarkable only for stupidity and indolence. The first ten years of his life were employed in learning to read and write his native language; the Bible and book of church hymns were his principal and favourite study; and his memory being naturally retentive, he easily remembered what he read from these volumes. From the prophetic books of the Old Testament, and the volume of hymns already mentioned, he caught the first glow of poetical inspiration; and to the latest period of his life, he recollected, and mentioned with emotion, the enthusiasm to which they had elevated his youthful mind.

Even so early as the expiration of his first *decennium*, Burger exhibited that symptom of a poetical disposition—the love of solitude; and without any external encouragement, or other learning, than that with which his hitherto very limited range of reading had supplied him, he began to write verses before he had been taught so much as the first principles of grammar and composition. His studies, in the mean time, proceeded but slowly; and the difficulty with which he was made to acquire a knowledge of the rules of Latin grammar appears extraordinary in a youth certainly of no mean talents. His father, a plain, sensible man, of some learning and great indolence, having in vain attempted to make his son comprehend the elements of that language, at length resolved to send him, in his 12th year, to his grandfather at Aschersleben, in order that he might have the advantage of attending the grammar school in that town. Here young Burger made some progress in Latin; but having, unfortunately, incurred the displeasure of the rector, in consequence of some satirical verses which he had composed in ridicule of one of his fellow pupils, his grandfather found it necessary to remove him to the *pædagogium* at Halle, in the year 1762. In 1764, he entered into the university of Halle, and became, at his grandfather's desire, although contrary to his own inclination, a student of divinity. He is even said to have preached once in a country church in the neighbourhood of Halle. Theological studies, however, were not congenial with the lively disposition of Burger; and his grandfather having got information, that the young man did not conduct himself in a manner suitable to his future vocation, recalled him from Halle. But Burger, it would seem, contrived to appease the anger of his offended relative; for he obtained his permission, not only to repair to Gottingen, at Easter, 1768, but to change his studies from theology to jurisprudence. At Gottingen, accordingly, he applied himself, for some time, with assiduity to his new course of study, and made considerable progress in acquiring a knowledge of the principles of the civil law; but the influence of his former dissipated habits became again apparent; and his grandfather having been informed of his manner of living, gradually withdrew from him his countenance and support, and appears to have regarded him as a depraved youth, whose case was entirely hopeless.

Meanwhile, however, Burger became associated with several men of genius at Gottingen, by whose generous assistance he was enabled to continue his studies, which were now principally directed to ancient and modern literature, and especially to poetry. During this period, he composed several of his songs and smaller pieces. In the year 1770, he contributed, along with his friends, Gotter and Boie, to the contents of the first poetical almanack which appeared in Germany; a species of publication, the idea of which was borrowed from the French. About this time, too, he composed his *Ode to Hope*, and his translation of the *Pervigilium Veneris*, an undertaking which he appears to have long meditated, and upon the execution of which he seems to have dwelt with feelings of peculiar gratification.

Being now well known and esteemed as a poet in Gottingen, Burger had an opportunity of cultivating his genius in the society of a number of young men of distinguished merit, then residing at the same university, several of whom afterwards made a conspicuous figure on the literary theatre of Germany. Among these may be mentioned the poets, Voss, Holty, and the two counts Stolberg. To these friends he communicated most of his pieces before their publication, and was, no doubt, indebted to them for many useful hints and emendations. In the year 1772, he obtained, through the interest of his friends, the situation of an officer of justice (*amtmann*) in the territory of Alten-Gleichen, in the neighbourhood of Gottingen. In 1774, he married his first wife, a daughter of the Hanoverian law-officer, Leonhart, at Niedeck. The place which had been procured for him, however, was neither of sufficient emolument, nor sufficiently congenial with the disposition and habits of the poet, to afford him much or permanent gratification; he therefore resigned it in 1784 in disgust, and in the following year returned to Gottingen.

During the period of his residence in the country, he composed his famous ballad of *Leonora*, and translated several of the books of Homer's Iliad into Iambic blank verse, which were published in the *German Museum*. Neither this translation, however, nor one which he afterwards attempted in hexameter verse, was ever completed; nor is it much to be regretted, that he should have relinquished a task, which was afterwards so well performed by count Frederick Stolberg, and by Voss. In 1778, he undertook the sole superintendance of the Gottingen poetical almanack; the former editor, Goekingk, having associated himself with Voss, in the management of a similar publication at Hamburgh. In the same year, he also published the first collection of his poems, which contained several new pieces, in addition to those which had already appeared in different periodical works.

On his return to Gottingen, in 1784, our author, whose pecuniary circumstances were far from being in a prosperous state, determined to devote himself entirely to his favourite literary pursuits, and to endeavour to qualify himself for the situation of a professor in the university. With this object in view, he began to read lectures on philosophy and the *belles lettres*, and to give private instruction to individual students. In the following year (1785), he married the youngest sister of his former wife, who had been carried off by consumption about twelve months before; a step which exposed him to much censure on the score of morality, but which appears to have been to himself a source of great comfort and happiness. But his happiness was of short duration; for his beloved partner, in whom his whole affections seem to have been centred, died of a hectic fever a few months after the celebration of the marriage. The blow fell heavily upon Burger; and, indeed, from this period, his life exhibits little else than a record of uninterrupted bodily and mental distress. The animal spirits, which had hitherto supported him through poverty, and privations of different kinds, seem now to have almost entirely forsaken him; and the stream of life, which had previously flowed along with a brisk, if not an equable current, now became dull and flaggy, and mingled with the muddy waters of melancholy and affliction. For some time, he devoted himself to the study of the works of the philosopher of Koningsberg, and read public lectures on the critical philosophy. Strong, however, as was the desire which he constantly manifested to excel as a teacher of philosophy, the infirm state of his health would not permit him to bestow that intense application upon those pursuits, which their nature necessarily required; and his exertions in this field of discipline, therefore, do not appear to have been attended with any remarkable success.

In the year 1787, his health derived some benefit from medicine; and he had the satisfaction of at length obtaining from the philosophical faculty the degree of doctor. Two years afterwards, he was appointed an extraordinary professor of philosophy, though without any salary; and, in the same year, he published the second edition of his poems, which comprehended, in addition to the contents of the previous edition, his *Hohes Leid*, which he appears to have considered as his best and most finished production,—two poems in commemoration of the fiftieth anniversary of the foundation of the university of Gottingen, and several other pieces.

In 1790, Burger most unadvisedly entered into a third marriage with a Swabian girl, after a poetical courtship, in which the first advances were made by the lady. The marriage proved a most unhappy one, and was attended with consequences which it is believed contributed to shorten the existence of the poet.

In 1792, he was judicially divorced from his wife, after having suffered a great deal of misery during the latter period of the subsistence of the union. A short while before the separation, Burger had caught a cold, which produced a hoarseness that adhered to him during the remainder of his life, and deprived him of the faculty of speaking in public. His situation now became truly deplorable. Without any certain means of subsistence, he was compelled to earn a scanty and precarious livelihood, by translating out of foreign languages for the booksellers. Meanwhile, his strength rapidly declined. In the month of October 1793, he was forced, by a feverish complaint, to confine himself to bed. Symptoms of consumption ensued; and, after a painful and lingering illness, which he bore with becoming fortitude, he expired on the 8th of June 1794, in the 47th year of his age. A small monument was erected to his memory in Ulric's garden at Gottingen, a spot which the poet was in the habit of frequenting at early hours, and which is now used as a public promenade and place of amusement.

The moral character of Burger was far from being a model of purity; yet, if his failings must be allowed to have been numerous, his acknowledged virtues may perhaps be allowed to soften the tone of rigorous censure. His friends have borne ample testimony to the benevolence, disinterestedness, and liberality of sentiment, which uniformly distinguished him; and have recorded instances of generosity and truly Christian charity, which do him infinite honour. An uncommon vivacity of feeling, and a want of steady principle in the general conduct of life, appear to have constituted the defective part of his character; and while the former frequently hurried him into errors, which reason must have acknowledged and reprobated; the latter removed every obstacle to the impetuosity of passion. An indolent and irresolute mind, unable to resist the seductive allurements that are presented to the senses, produced a life which was too much marked by irregularity and dissipation; and actions which will not stand a trial, according to the strict tests of religion and of virtue.

Upon the poetical character and merits of Burger, we can dwell with more unmingled pleasure. Although all of his numerous productions will by no means satisfy the rigorous demands of taste and criticism; yet there will be found, in general, throughout his works, a spirit of originality, a copiousness of poetical imagery, an energy and fire of language, and a harmony of versification, which indicate the offspring of no ordinary genius. Of these excellencies, his *Pervigilium Veneris*, his *Ode to Hope*, his *Hohes Lied*, the two poems on the fiftieth anniversary of the foundation of the University of Gottingen, and others, afford abundant examples. His defects, which, however, are more than compensated by his acknowledged beauties, may be partly ascribed to the peculiarities of his genius, and partly flow, as a necessary consequence, from the system he professed and pursued, in regard to poetical composition. He possessed more vigour and originality, than chasteness and disciplined thought; more boldness and luxuriancy of imagination, than correctness of judgment or refinement of taste. Like some writers of poetry in our own country, he avowedly looked upon popularity as, at once, the greatest proof of literary merit, and the highest reward of poetical exertion; and not that species of popularity which is conferred upon an author by the suffrages of the truly learned and discerning, but that which is acquired by condescending to adopt the feelings and prejudices, and even the very language, of the illiterate and the vulgar. To this erroneous system he too frequently sacrifices the rules of art, and the feelings of propriety, and gives to his effusions an occasional coarseness, which is apt to offend a critical and refined reader. Some of his sonnets and smaller pieces, too, however beautiful in diction and versification, betray too much of the individual character, sensations, and sufferings of the author: They not only exhibit pictures of individual and peculiar dispositions and emotions of the mind, but are, in fact, the offspring of these peculiar and temporary feelings; feelings too minute and particular to be fully comprehended and enjoyed by the reader, and often too violent to permit a free exercise of the poet's powers.

In one species of poetical composition, however, Burger has few rivals. His ballads, whether original or imitated, exhibit a richness in all the different essential qualities of that kind of writing, which has seldom been equalled, and perhaps never surpassed. In simplicity, energy, pathos, and humour, according to the nature of his subject, he always displays powers as excellent as they are various. His attention had been drawn, at an early stage of his literary career, to Percy's "Relicks," a collection which he perused with delight, and of which he translated some of the contents. Several of his ballads, however, are unquestionably original. An attempt, indeed, was made in the Monthly Magazine, (September 1796,) to show that Burger had taken the story of his *Leonora*, from an old English ballad, *The Suffolk Miracle*. But, in the first place, it is extremely improbable that Burger ever saw this supposed original; and, in the second place, it is certain that he used to give his friends a very different account of the matter, and we do not understand that his veracity was ever called in question. The first idea of writing such a ballad, he said, was suggested to him by hearing a peasant girl sing, by moonlight, some verses, of which he recollected only three lines, which we translate thus:

> "The moon it shines so bright,
> The dead ride fast by night:
> Sweet love, art not afraid?"

From which it appears very probable, that an old ballad, somewhat similar in its subject, had existed at one time in Germany. After all, in a poem such as *Leonora*, it is not so much the invention, as the manner of execution, which evinces the genius of the author; and, in this latter respect, the merit of Burger is indisputable.

The amateurs of German literature are probably familiar with his other ballads, "*Der Wilde Jager*." (which has been translated, or rather imitated, by Mr Scott;)

"*Die Weiber von Weinsberg;*" "*Des Pfarrers Tochter von Taubenhain;*" "*Das Lied von Treue,*" &c.; besides his translations from the English, which will not shrink from a comparison even with their beautiful originals.

The ballad of *Leonora* has been frequently translated. The admirers of splendid specimens of typography are acquainted with the elegant version of Mr W. Spencer, beautifully printed in folio, with engravings, from admirable designs, by Lady D. Beauclerc. See the Life prefixed to the fourth volume of Burger's works, published by Reinhard, in four volumes 8vo. Gottingen, 1796, and following years; and Schiller's *Review of Burger's Poems*, in the 4th volume of that author's prose writings, Leipsic, 1802. (*z*)

BURGESS, in a general sense, denotes an inhabitant of a borough; but in a more restrained and proper meaning, it signifies the *freemen* only of the borough, or those who, by fine, parentage from a freeman, marriage with a freeman's daughter, or gratuitous favour of the borough, are entitled to certain privileges of trade or otherwise. It appears from the *Leges Burgorum*, that in the royal boroughs of Scotland, property to the extent of at least a rood of land, holding of the crown, and burdened with the service called *burgagium*, was anciently a requisite qualification towards becoming a burgess. It appears, too, from the records in the reign of Robert II. and James I., that, of old, the individual proprietors of tenements in these boroughs had charters from the king, as other freeholders, from which the practice of magistrates receiving vassals in burgal tenements as the king's bailies, has no doubt arisen.

That part of the representatives in parliament who are returned by the boroughs, are also sometimes denominated *burgesses*, in contradistinction to the knights of the shires, or county representatives, although, in fact, they also are generally proprietors of county lands. (J. B.)

BURGLARY (*Burgi latrocinium,*) or nocturnal housebreaking, in law, signifies an unlawful entering into the dwelling-house of another, in the night-time, with the intention of committing some felony.

In burglary there are four things to be considered: the *time*, the *place*, the *manner*, and the *intent*.

1. The *time* must be *night;* for the like offence committed by day is called *house-breaking*, to distinguish it from burglary, which is committed by night. Antiently, the day was reckoned to begin only at sun-rising, and to end immediately at sun-set; but the better opinion seems to be, that if there be day-light enough, begun or left, to enable one to discern a man's face, it is no burglary. But this principle does not extend to moon-light.

2. The *place*, according to Sir Edward Coke, must be a *mansion-house*; and, therefore, to account for the reason why breaking into a church is burglary, he quaintly observes, that it is *domus mansionalis Dei*. But it does not seem absolutely necessary that it should, in all cases, be a mansion-house; for a burglary may be committed by breaking the gates or walls of a town by night. According to Spelman's definition, burglary is "*nocturna diruptio alicujus habitaculi, vel ecclesiæ, etiam murorum portarumve burgi, ad feloniam perpetrandam.*" And we may, therefore, conclude, that the requisite of its being *domus mansionalis* is only in the burglary of a private house. No distant barn, however, warehouse, or the like, are under the same privileges as a man's dwelling-house; nor empty houses, wherein no one resides. But burglary may be committed in a house where a man sometimes resides, and which the owner hath left for a short time, *animo revertendi;* although no one should happen to be in it at the period of committing the crime. A burglary may also be committed in the barn, stable, or warehouse, if they be parcel of the mansion-house, though not under the same roof, or contiguous. A chamber in a college or inn of court, where one usually lodges, is to all intents and purposes the mansion-house of the owner; for every inhabitant hath a distinct property therein. So also is a room or lodging, in any private house, the mansion-house, for the time being, of the lodger, if the owner do not himself live in the house, or if he and the lodger enter by separate outward doors, otherwise, however, lodgers are considered only as inmates, and their chambers as parcel of the dwelling-house of the owner. The house of a corporation is their mansion house, and not that of the respective officers who may inhabit its separate apartments. A shop hired for the purposes of work or trade, and not used as a dwelling, is not considered as a mansion-house, nor can a burglary be committed therein. Neither can burglary be committed in a tent or booth erected in a market or fair, even although the owner should lodge in it. The entering into the work-shops of the plate-glass manufactory, with intent to steal the stock or utensils, is made single felony, and punished with transportation for seven years, by 13 Geo. III. c. 38.

3. With regard to the *manner* of committing burglary, there must be both a breaking and an entry to complete the offence. But it is not necessary that they should both take place at the same time; for if a breach be made one night, and the same breakers enter through it the next night, they are burglars. In general, there must be an actual, and not merely an ideal breaking; such, at least, as breaking or taking out the glass, or otherwise opening a window; picking a lock, or opening it with a key; lifting up the latch, or unloosing any other fastenings of a door. But if doors or windows are negligently left open, and a man enters, it is no burglary, unless he afterwards unlocks an inner or chamber door. To come down a chimney is held to be a burglarious entry. If a man enters by an open door, and breaks open a chest, it is no burglary; but it is so, if he breaks open a cupboard or other fixture. If a person knocks at a door, and upon its being opened, rushes in, with a felonious intent; or, under pretence of taking lodgings, falls upon the landlord and robs him; or procures a constable to gain admittance, in order to search for traitors, and then binds the constable and robs the house: all these are deemed burglarious entries, although there be no actual breaking. So, likewise, if a servant opens and enters his master's chamber-door with a felonious design; or if a person lodging in the same house or inn, opens and enters another's door with an evil intent. If a servant conspires with a robber, and lets him into his master's house by night, both are implicated in the crime. The least degree of entry with any part of the body is sufficient to constitute a burglary; such as stepping over the threshold, putting a hand or a hook in at a window to draw out goods, or a pistol to demand one's money. The entry may be before the breaking as well as after it; for by statute 12 Ann. c. 7. if a person enters the dwelling-house of another, by day or night, without breaking in, with intent to commit felony, or being in the house, shall commit felony and then break out by night; this is declared to be burglary. When several persons

come together, with a design to commit burglary, and one does it, while the others watch near the house, the act of one is considered as the act of all.

4. The breaking and entering must be made with a felonious *intent*, otherwise the offence amounts only to a trespass. It is the same thing, however, whether the intention be actually carried into execution, or only demonstrated by some overt act.

Burglary is a felony at common law, but within the benefit of clergy. By the statutes 1 Edw. VI. c. 12. and 18 Eliz. c. 7. however, clergy is taken away from the principals; and by 3 and 4 William and Mary c. 9. from all accessaries before the fact. By the statute 10 and 11 William III. c. 23. any person who shall convict a burglar shall be exempted from parish and ward offices where the offence was committed. To this exemption a reward of 40*l.* is superadded by the statutes 5 Ann. c. 31. and 6 Geo. I. c. 23. If an accomplice, being out of prison, shall convict two or more offenders, he is entitled to a pardon of the felonies enumerated in the act. And by the statutes 25 Geo. II. c. 36., 27 Geo. II. c. 3., and 18 Geo. III. c. 19., the charges of prosecuting and convicting a burglar shall be paid by the treasurer of the county where the burglary was committed, to the prosecutor and poor witnesses. The statute 23 Geo. III. c. 88. enacts, that any person who shall be apprehended, having upon him any pick-lock key, &c. or other implement, with intent to commit a burglary, shall be deemed a rogue and a vagabond within the statute 17 Geo. II. c. 5. And by the statute 10 Geo. III. c. 48. the buyers and receivers of jewels, gold, or silver plate, carried off in a burglary, may be tried and transported for fourteen years, before the conviction of the principal. Blackst. *Comment.* B. iv. ch. 16.; Jacob's *Law Dict.* (*z*)

BURGOS, a city of Spain, and capital of Old Castile, is situated on the declivity of a hill, on the right bank of the river Arlanzon, whose stream flows close to its walls. It is supposed by some writers to be the Braum or Bravum of Ptolemy, but others refer its origin to the site of another city called Aura, as late as the ninth or tenth century. It is a large irregular town, presenting the figure of a cross, surrounded by high walls, and was formerly protected by a castle of considerable strength, erected on the brow of the adjacent hill, of which some vestiges still remain. The streets are narrow, crooked, and badly arranged; and of its numerous squares, one only is deserving of notice. It stands in the middle of the city, and is surrounded by a piazza, supported by lofty pillars, over which are some tolerably handsome houses. The principal approach to the city is by the gate of Santa Maria, which opens on one of the bridges over the Arlanzon. This gate was built to commemorate the founders of the Castilian monarchy, and the illustrious men who had contributed to its honour and aggrandizement, with whose statues it is still adorned. Among these are Fernando, Gonzalez, Charles I., the Cid, and Diego Porcel. The suburbs of Burgos, which are called De Bega, lie on the opposite side of the river, which is crossed by three free-stone bridges. Here is a beautiful promenade, enlivened by the intermixture of delightful gardens, which are constantly refreshed with fountains of water. Among the public buildings are the hotel de Ville, the palace of Velasco, and the triumphal arch erected in honour of Fernando Gonzalez, first count of Castile. The cathedral church is one of the finest and best preserved specimens of Gothic architecture in Spain. It was built about the beginning of the 13th century, by Ferdinand III., but was not completely finished till some centuries after. This church is embellished with towers, columns, statues, and other ornaments, which are executed with exquisite delicacy and neatness, and contains eight chapels, in which divine worship is regularly performed, and which are adorned with some beautiful paintings by Raphael and Michael Angelo Buonarotti. The church of St Paul's is also a noble Gothic structure, with an altar of the Corinthian order; and the convent of the Augustines, which stands in the suburbs, is famous for its chapel of the holy crucifix, which is enriched with the collective tribute of kings, nobles, and private individuals. According to tradition, this crucifix was constructed by Nicodemus, and possesses miraculous powers. It is an exact outline of the human figure, and is covered from the waist to the feet with a kind of petticoat, full plaited, and of the finest cloth. It is concealed behind three curtains, and is only exhibited on great occasions, and always with pompous solemnity. There are also several handsome convents and hospitals, particularly the monastery *de las Huelgas*, and the royal hospital, which is richly endowed, and remarkable for its cleanliness and healthy situation.

Burgos has a college for the education of youth, and also an academy for the polite arts, both of which are exclusively supported by the merchants. A surgical school was instituted here in 1800; but, unfortunately, its professors were chosen without any regard to their character and abilities.

This city was erected into an archbishopric in 1574. Its diocese comprehends a cathedral chapter, six collegiate chapters, eight archpriests, and six hundred and ninety-three parishes. The cathedral chapter includes 17 dignitaries, 30 canons, 26 prebends, and 19 chaplains. Burgos is the residence of the intendant for the province of the same name, and has also a corregidor, and an alcaide.

As long as Burgos was animated by the presence of its sovereign, it continued to enjoy splendour and pre-eminence; commerce flourished, industry was excited, and manufactures were multiplied. Its crowded fairs displayed wealth and prosperity; and it was the entrepot of all the trade that was carried on from the interior of Spain with the several ports on the bay of Biscay. It was also the residence of many foreign merchants; and the famous Segovian cloth was transmitted from this city to every quarter of Europe. But, when Charles V. transferred the seat of royalty, in the beginning of the 17th century, to Madrid, its prosperity began rapidly to decline; and, before the conclusion of a century, it was impoverished and depopulated. Of its 40,000 inhabitants, scarcely 9000 remain. A little cloth, and some fine woollen stockings, called *bas d'etaim*, are its principal manufactures; and its only trade consists in the exportation of the woollen cloths of Old Castile, from which it derives a considerable profit. It is 112 miles north of Madrid. West longitude 3° 38′. North latitude 47° 10′. See Laborde's *View of Spain*, vol. iii. p. 14; and Bourgoing's *Travels in Spain*, p. 19, in Phillips's *Coll.* vol. ix. (*p*)

BURGUNDY, or BOURGOGNE, anciently a powerful kingdom in Gaul, was first established by the Burgundians, a German nation, in the beginning of the fifth century. This people formerly occupied the countries of the present Thuringia and Lusace, on either side of the Elbe, and were supposed to have been descended from the Roman soldiers who had been left to garrison the conquests of Drusus; though Pliny decidedly asserts, that they were a tribe of the Vandals. ("Vindili, quorum pars Burgundiones," *Hist Nat.* iv. 28.) Before their emigration from the shores of the Baltic, they were engaged in almost constant hostilities with the Alemanni, concerning their respective boundaries, and it was in conjunction with that nation that they made their first appearance on the Rhine, in the reign of the emperor Tacitus. After repeated irruptions into the empire, they at last obtained a grant from the usurper Jovinus, to settle in that part of Gaul which borders on the Rhine, under their king Gundicar, in 413; and this grant was afterwards confirmed by the emperor Honorius, upon condition that they should assist the Romans, and serve in his armies as subjects of the empire. Their irruptions, however, were continued; and, leaguing themselves with the other barbarians from the north, they entered Belgic Gaul, committing unparalleled ravages wherever they came. But their army was at last completely defeated by Ætius the Roman general, when they were compelled to sue for peace. Ætius afterwards removed them into Sabaudia, now Savoy, an extensive tract between the Rhone and the Alps; and here they gradually dilated their boundaries until 490, when the territory of Gundobald, the Burgundian king, comprehended modern Burgundy, almost the whole of Switzerland and Dauphiné, with a part of Provence and Savoy, and had Vienna for its capital. This monarch had sacrificed to his fears of a rival, two of his brothers, one of whom was the father of Clotilda, queen of the Franks; but had permitted the youngest to live, and to possess the dependent principality of Geneva. The prosperity of the Burgundians, however, was but of short duration. Clovis, king of the Franks, had spread his conquests over the finest provinces of Gaul, and was stopped only by the power and the valour of Gundobald. But the defection of Godegesil, the brother of the Burgundian king, decided the fate of his country; and Gundobald was compelled to yield to the arms of Clovis, and condescended to pay a yearly tribute to his conqueror. Upon the death of Gundobald in 509, his son, Sigismund, ascended the throne. The first act of his reign was to acknowledge his subjection to the emperor of Constantinople; and the second, that is worth recording, was the inhuman murder of his innocent son, to satisfy the pride and resentment of a step-mother. This he afterwards attempted to expiate, by austere devotion, and liberal donations to the monastery of St Maurice in Vallais, which obtained for him the honours of a saint and a martyr. But a more dreadful expiation awaited him from the sons of Clovis, who, with a powerful army of Franks, came to revenge upon the son of Gundobald the murder of their grandfather. After an unsuccessful battle in 523, Sigismund fled to the desert, and attempted to conceal himself, under the habit of a monk; but, being discovered and betrayed by his own subjects, he was condemned, with his wife and two children, to be buried alive in a deep well at Orleans. The Burgundians submitted for a short while to their invaders, when, revolting under Gondemar, the brother of Sigismund, they recovered their independence after a severe struggle, but maintained it only for eight years. The sons of Clovis again entered Burgundy; and, in 534, completed the conquest of the kingdom, when Gondemar was obliged to save himself by flight; and his subjects were reduced to pay an annual tribute, and to serve in the armies of their conquerors. But, though now under the dominion of the Franks, they continued to enjoy their national laws, until the reign of Louis-le-Debonnaire, in the beginning of the ninth century, when they were incorporated with the other subjects of the French monarchy.

Upon the death of Charles the Bald, in 879, Burgundy was dismembered of the greatest part of its territories Burgundia Cis-Jurana, or that part of it west of mount Jura (now St Claud,) was added to the kingdom of Provence, which had been given to Boson, the brother-in-law of Charles; and Burgundia Trans Jurana, which comprehended Switzerland, the Valais, the Genevese and Chablais, was given to Rodolph, the son of Conrad, Earl of Paris, in 888. What remained of the ancient kingdom of Burgundy was converted into a duchy, and continued subject to its own dukes, until it was finally united to the crown of France by Louis XI. in 1478. Its history during that period, however, is so completely involved in that of France, that we must refer our readers to that article. At present, we shall only remark, that the dukes of Burgundy, by their various and extensive possessions, were regarded at one time as the most considerable princes in Europe. Many of them rose to the throne of France. They were named, by a decree of Bayle in 1433, the first dukes of the Christian world, and held the next rank to kings.

The province of Burgundy, before the revolution, extended 45 leagues in length, and about 30 in breadth, and was bounded by Champagne on the north, by Franche-Comté on the east, by Lyonnois on the south, and on the west by Bourbonnois and Nivernois. It is divided by a chain of mountains, extending from Dijon to Lyons; on the east of which is one extensive and fertile plain, terminated by the mountains of Franche-Comté and Savoy; but on the west, the country is rather hilly, and in many places dry and uncultivated. The soil throughout the province, however, is in general excellent, but so varied, that almost every district is adapted for a particular species of cultivation. It produces various kinds of grain and fruits, tobacco, hemp, and flax. The wool which is annually derived from their flocks, amounts to between three and four thousand pounds, two thirds of which is manufactured in the province; and its wine is esteemed among the best in the world, and is drunk throughout all Europe. The produce of its vineyards, in common years, is estimated at 100,000 hogsheads. Those of Mont-Rachet and Romané yield the most esteemed wines; though the wines of Vollenay and Pomard are reckoned the most delicate.

Iron mines are found in almost every district, and supply above 30 forges in the province, from which 60,000 quintals of iron are annually transported to different parts of France. But the expence of land-carriage prevents it from being in general requisition, as the maritime provinces can obtain this metal at a cheaper rate from Sweden. Burgundy has also several coal mines, and abounds with an infinite variety of stones, which are capable of a high polish, and equal in beauty to any marble.

The manufactures of Burgundy are principally confined to woollen stuffs, such as drabs, serges, druggets, and blankets; of which it is computed that from 12 to 13 thousand pieces are annually wrought from the wool of the country. They are, however, chiefly consumed in this and the neighbouring provinces. It has several paper manufactories; and its delf-ware is equal to any in France.

The principal rivers of this province are, the Seine, the Yonne, the Ain, the Saone, the Rhone, the Seille, the Loire, the Arroux, and the Doubs; all of which are navigable. The *Canal de Bourgogne* joins the Saone and the Seine, by the river Yonne, and extends from Saint Jean de Losne to the village of La Roche near St Florentin, about 50 leagues in length. Part of it, however, is still unfinished (1812,) and the communication is open only as far as Dijon. Another canal, called the *Canal de Digoin*, or *Canal du Centre*, unites the Saone and the Loire from Chalons to Dijon. It is about 24 leagues in length, and contains 81 sluices.

The population of Burgundy, according to M. Bonvallet des Brosses, amounted to 1,072,800, allowing 800 for every square league, of which he reckons 1341. The name of Burgundy, by the republican division of the country, was blotted from the map of Europe, and it is now distributed into the departments of the Yonne, the Cote d'Or, the Saone and Loire, and the Ain; which see under their respective names. See also Peuchet *Dictionnaire*, &c.; Gibbon's *Rom. Emp.* vol. vii. p. 274, &c. 12mo.; and Tynna *Almanach du Commerce*, 1811. (*p*)

BURIAL, denotes the act of interring the body of a person deceased.

Although the mode of disposing of the body after death, has varied in different ages and countries, yet devotional feelings, combined with a sense of decency, as well as a regard to health and comfort, seem to have universally pointed out to mankind the propriety, not only of removing out of sight the dead bodies of their fellow-creatures, but of performing this act with certain solemnities, which are considered as a natural tribute of respect from the living to the dead. And as these ceremonies have been generally regarded as religious rites, they have seldom been denied but to persons who had made themselves guilty of some flagrant violation of the laws of God and of nature.

Of the various modes of burial which have prevailed in the world, *inhumation*, or simple interment, according to the opinion of Cicero, as it is the most natural, appears to have been also the most ancient: *Redditur enim terræ corpus, et ita locatum ac situm, quasi operimento matris obducitur. De Leg.* ii. 22. The practices of *burning* dead bodies, of enclosing the remains in urns, *embalming*, &c. appear to have been of later date, and to have derived their origin from the dread of inhuman treatment after death, from motives of affectionate regard in surviving relatives, or from the pride and vanity of individuals.

In discussing the subject of burial, there are four points particularly deserving of attention: The importance which mankind in general have attached to the act; the ceremonies with which it has been accompanied in different ages, and among different nations; the places set apart for interment; and the laws relative to the practice of burial.

1. From the earliest historical records, it is evident that burial was considered by mankind, in the most ancient times, as an object of the highest importance. In the Old Testament scriptures, we meet with many passages which prove this to have been the case among the Jews; who not only betrayed, at all times, an anxiety with regard to the rites of sepulture, and were extremely careful about the burial of their dead, but considered the deprivation of burial as one of the most disgraceful things which could befall a man. When the Lord foretold to Abraham the afflictions which should come upon his race, he added, as a source of consolation, that he himself should go to his fathers in peace, and should be *buried in a good old age*. (Gen. xv. 15.) Upon the death of Sarah, his wife, Abraham earnestly besought the sons of Heth, to give him possession of a burying-place; and his request being granted, he purchased of Ephron, the son of Zohar, the field of Machpelah, and the cave which was therein, for four hundred shekels of silver. Abraham, accordingly, buried Sarah in the cave of the field of Machpelah, which afterwards served as a place of interment for his own body, and for those of Isaac and of Jacob. Many other passages occur, in which the duty of sepulture is inculcated, and instances of the discharge of it are recorded. David gives great praise to the men of Jabez-Gilead, for rescuing the bones of their king and prince from the enemy's walls, and committing them to their family vault. (2 Sam. ii. 5.) The scriptures threaten the wicked with being deprived of burial, as if such deprivation were one of the greatest calamities that could befall them. "If a man beget a hundred children, and live many years, so that the days of his years be many, and his soul be not filled with good, *and also that he have no burial*, I say, that an untimely birth is better than he." (Excles. vi. 3.) Jeremiah also threatens the kings, priests, and false prophets, who had worshipped idols, that he would have their bones thrown out of their graves, like dung upon the earth. (Jerem. viii. 2.) The same prophet foretold, that Jehoiakim, the wicked king of Judah, as a severe punishment for his guilt, should be buried with the burial of an ass;—that he should be cast out of the gates of Jerusalem into the common sewer. (Ibid. xxii. 18, 19.) That good men considered it to be a part of their religious duties to bury the dead, appears from the example of Tobit, who went about burying the dead bodies of his murdered countrymen, at the hazard of his own life.

Similar sentiments with regard to the importance of burial, appear to have prevailed also among the heathen nations of antiquity. Both the historical and the poetical works of the Greeks clearly prove, that even in their most flourishing period of prosperity and civilization, they considered it essential to their happiness to be buried and honoured with certain ceremonies after death. Solon, in his conversation with Crœsus, (Herodot. *Clio*, 30—32,) plainly intimates, that he considered a public funeral,—a magnificent interment, as a source of happiness. More than one of the Greek dramas, and, among these, the most esteemed tragedy of Sophocles, the *Antigone*, derive their whole interest from a contest about the right of burial. The fate of the twelve Athenian commanders, who suffered death because they had been prevented from recovering and burying the dead bodies of their countrymen, after a naval fight, is well known. The ancient Greeks and Romans, indeed, were strongly persuaded, that their souls would not be admitted into the Elysian fields, till their bodies were committed to the earth; and if it happened that they never obtained the rites of burial, they were supposed to continue in a wandering state, excluded from the mansions of the blest, for a term of one hundred years. Hence the imperious duty, incumbent upon all travellers who should happen to meet with a dead body in their way, to cast dust upon it three times; of which three handfuls, one at least was cast upon the head. He who encountered an unburied body without performing this ceremony, drew upon himself a curse, which no sacrifice could remove. Horace, accordingly, makes the shade of Architas to beg this service of a passing seaman:

> At tu, nauta, vagæ ne parce malignus arenæ
> Ossibus et capiti inhumato
> Particulam dare. Sic, quodcunque minabitur Eurus
> Fluctibus Hesperiis, Venusinæ
> Plectantur silvæ, te sospite; multaque merces,
> Unde potest, tibi defluat æquo
> Ab Jove, Neptunoque sacri custodi Tarenti.
> Negligis immeritis nocituram
> Postmodo te natis fraudem committere forsan.
> Debita jura vicesque superbæ
> Te maneant ipsum: precibus non linquar inultis;
> Teque piacula nulla resolvent.
> Quanquam festinas, non est mora longa; licebit
> Injecto ter pulvere curras.
>
> *Carm.* 1. 28.

Herodotus informs us, (*Euterp.* 90.) that in Egypt, if any person, native or foreigner, was found either destroyed by a crocodile, or drowned in the water, the city nearest which the dead body was discovered was obliged to embalm it, with every mark of respectful attention, and afterwards deposit it in some consecrated place. Isaeus adduces it as a proof of Cleon's not being the son of Astyphylus, that he neither buried him, nor performed his funeral exsequies. A law of Athens compelled the burial of a dead body found by accident, and pronounced him impious who refused. Servius on Virgil (*Æneid* vi. 176.) says, that writers on morals rank the interring of the dead among the first of moral duties. Thus, too, although a priest was contaminated by merely looking on a dead body, yet it was considered the height of impiety to leave it unburied. Some individuals, however, appear to have dissented from this almost universal opinion of the sacred duty of interment. The Cynics seem to have regarded burial with contempt; and Pliny (*H. N.* l. vii.) classes the concern manifested about it among the weaknesses of human nature. But the importance attached to it, in the general estimation of mankind, is sufficiently obvious from the facts already mentioned, from the denial of the privilege of interment to persons in particular situations, and from the circumstance of disgrace attending the funerals of some of those to whom it was allowed. Persons killed by lightning were buried apart by themselves, being deemed odious to the gods; those who wasted their patrimony, forfeited the right of being buried in the sepulchres of their fathers; and those who were guilty of suicide, were privately deposited in the earth, without the usual solemnities—That those sentiments with regard to the importance of burial, have descended, in a great measure unimpaired, to modern times, proves that they are deeply implanted in the human breast; and that, if they belong to the weaknesses of our nature, they are too univiversally prevalent, and too firmly rooted, to be easily eradicated by the efforts of philosophy.

2. The ceremonies observed in burying the dead have varied in different ages, and among different nations. The two modes of burial chiefly practised by the ancients were cremation and simple interment. Of these, we have already observed, interment, or inhumation, appears to be of earliest date. The custom of burning, however, is probably very ancient; and we have several examples of it in the Old Testament scriptures. Saul, we are informed, was burnt at Jabesh, and his bones afterwards buried; and Asa was burnt in the bed which he had made for himself, filled with sweet odours and divers kinds of spices. But the practice of burning, we are assured, existed neither in Persia nor in Egypt: The Persians thought it profane to feed a divinity with carcases; and the Egyptians abhorred it on another account, being fully persuaded that fire was a voracious animal, which devoured whatever it could seize, and which, when satiated, expired with what it had consumed. Among the Greeks and Romans, the practice of cremation prevailed, but not universally. Both Virgil and Ovid mention the custom of burning as being general before the foundation of Rome. (*Æneid*, xi. 208. *Fast.* iv. 853.) Inhumation, however, Cicero observes, (*De Leg.* ii. 22.) was preferred by Numa, the Cornelian family, and Marius. But cremation seems still to have been generally practised. Tacitus (*Ann.* xvi. 6.) says, Poppæa's corpse was not burnt, according to the Roman fashion; which shews the prevailing custom at that period. And it is a misapprehension of Capitolinus's words, to suppose that Antoninus prohibited it; for Macrobius, (vii. 7.) who lived during the reign of Theodosius the Younger, speaks of it as being left off only in his time. Among the Hindoos, the practice of burning the dead has prevailed from the remotest times. Several ancient authors also mention the unnatural custom of the women in India burning themselves with the bodies of their husbands, which seems to be of great antiquity. Thus Propertius:

> Et certamen habent leti quæ viva sequatur
> Conjugium; pudor est non licuisse mori.
> Ardent victrices, et flammæ pectora præbent,
> Imponuntque suis ora perusta viris,
>
> Lib. iii. El. 13.

Cicero, in his Tusculan questions, likewise mentions the same fact. "The women in India," says he, "when their husband dies, eagerly contend to have it determined which of them he loved best, for each man has several wives. She who conquers deems herself happy, is accompanied by her friends to the funeral pile, where her body is burnt with that of her husband; they who are vanquished depart in sorrow." It is evident, however, that the custom of burning the dead was at one time prevalent among the northern nations of Europe, as well as among the Greeks and Romans, and the inhabitants of Asia. The author of *Ynglinga Saga*, published by Snorro Sturleson, in his history of the kings of Norway, ascribes the introduction of this practice to Odin, after his settlement in the north. But he views it, at the same time, as borrowed from the Asiatics. Odin, he says, enforced those laws in his own dominions, which were formerly observed among the inhabitants of Asia. He enjoined that all the dead should be burnt, and that their goods should be brought to the funeral pile with them; promising that all the goods thus burnt should accompany them to Walhalla, and that there they should enjoy what belonged to them on earth. He ordered that the ashes should be thrown into the sea, or be buried in the earth; but that men remarkable for their dignity and virtue should have monuments erected in memory of them; and that those who were distinguished by any great action should have grave-stones, called *Bautasteina*. (*Yngl. Sag.* c. 8.) Sturleson speaks of two distinct ages. The first, he says, was called *Bruna-aulla*, (the age of funeral piles,) during which it was customary to burn all the dead, and to erect monuments over them, called *Bautasteina*. From the time, however, that Danus Mikillati, the great king of the Danes, caused a tomb to be made for him, and gave orders that he should be buried with all the ensigns of royalty, with all his arms, and with a great part of his riches, many of his posterity followed his example. Hence the age of graves (*Haugs-olld*) had its origin in Denmark. But the age of funeral piles continued long among the Swedes and Normans. (*Pref. to Hist.* p. 2.) Danus Mikillati was born A. D. 170. A similar distinction of ages appears to have existed among the Norwegians, in ancient times. We find one Atbiorn, in an address to Hacon the Good, on occasion of a general convention of the people, dividing the time past into the age of funeral piles, and that of graves. (*Saga Haconar*, c. 17.) It is a fact not generally known, that the inhuman custom which prevails in Hindostan, of burning wives with their dead husbands, was common among the northern nations. Not only did it exist among the Thracians, the Heruli, the inhabitants of Poland and of Prussia, during their heathen state, but also among the Scandinavians. (Oddo, *Vit. Olai Trygguason.*) It appears, however, that widows were not burnt alive; but that, according to the custom of the country, they previously put themselves to death. The reason assigned for this horrid law was, that their nuptial felicity would thus be continued after death in Walhalla, which was their heaven. (See Bartholin. *de Causis Contempt. Mortis*, 506—510. Jamieson's *Etymolog. Dict.* v. BAYLE-FYRE.) The introduction of Christianity appears to have put a stop to the practice of burning the dead; and interment came, at length, to be universally adopted by those nations which were converted to the true faith.

We shall now proceed to give some account of the various funeral solemnities which have been practised among different nations, and in different ages of the world, so far as they can be collected from credible authorities.

Among the Jews, all those who happen to be present when any person has just expired, tear their clothes, according to the ancient custom of the Hebrews. The dead body is then placed on a sheet spread on the pavement, with the thumb turned inward to the hand, and a wax taper burning at the head or feet. The deceased is washed, and a clean shirt put upon him, and over the shirt a garment of fine linen, which he wore on the day of solemn expiation; then his *taled*, which is a piece of square cloth with tufts. Lastly, a white cap is put on his head, and he is then shut up in the coffin. Anciently, it appears to have been a custom in Palestine, to embalm the bodies of persons of distinction and fortune; but this was never generally practised. After the body has been exposed, the relations meet to accompany it to the ground. In ancient times, they had women hired to cry, and persons who played on doleful instruments, and who walked in procession. Persons who met the funeral procession in civility joined the company, and mingled their groans. At the place of burial, the coffin is set down on the ground; then, if the deceased was a person of rank, some one makes his encomium: after which they walk ten times about the grave, repeating a long prayer, beginning, "God is the rock, his way is perfect," &c. (Deut. xxxii. 4.) The body is then let down into the grave, with its face turned towards heaven; the nearest relations throw the earth upon it, and the grave is filled. When they depart from the spot, they walk backward, and pulling up some grass three several times, they throw it behind their backs, repeating, "They shall flourish like the grass of the earth." Ps. lxxii. 16. (See Calmet's *Dict. of the Bible*, v. DEAD.)

The funeral solemnities of the Greeks seem to have varied, according to the peculiar sentiments and habits of the different states, and the rank and condition of the deceased. In general, the poorer classes were interred in public cemeteries, without any great external pomp or mark of distinction. Persons of fortune, on the other hand, were usually buried with much splendor. Of these, some were burnt to ashes on a magnificent pyre, and their ashes carefully collected and deposited in an ornamented urn; while others were embalmed, after the Egyptian fashion, and then removed to some stone or marble tomb provided for the express purpose.

The Athenians were much more ceremonious than any other people in regard to the burial of their dead. Their funerals were frequently celebrated with the most extravagant pomp; which at one period was carried to such an extreme, that Solon was compelled to introduce and enforce a law for its moderation. Dirges, or funeral songs, often of exquisite beauty, were adapted to music, and not only sung or repeated over the grave or funeral pyre, but afterwards recited, in full band, while funeral games and exercises were performed at the place of sepulture. But this extravagant pageantry, which was conferred upon all who were rich enough to afford it, was greatly exceeded on the death of any distinguished patriot or warrior; on which occasions, the expence incurred, which was generally enormous, was always discharged by the community. Of this extreme prodigality we have an example in the funeral of Evagoras; and also in that of Demetrius, which is related at large by Plutarch, *in Vit. Demetr.* See Mason Good's *Lucretius*, b. iii. v. 923, N. But the most magnificent public funeral, perhaps, of which we have any account, was that of Alexander the Great, when his body was brought from Babylon to Alexandria; a minute description of which is given by Diodorus Siculus.

The manner in which the funerals of those who died in defence of their country were solemnized at Athens, is worthy of particular notice, as it cannot fail to afford us an elevated idea of that polished and patriotic people. On a day appointed, the bones of the deceased, contained in a number of coffins made of cypress wood, were placed beneath a large tent erected for the purpose, and exposed to the public view; so that all those who had relations to deplore, might assemble to weep over them, and to perform the duties which tenderness dictated, or religion enjoined. Various sorts of odoriferous herbs and flowers were brought to the spot by the friends of the departed, and strewn around the tent. Three days afterwards, the coffins were placed upon as many cars as there were tribes; with an empty hearse, in memory of those who could not be found. These were carried slowly, in procession, through the town to the *Ceramicus*, or public place of burial, where funeral games were celebrated in honour of the deceased. The bodies were then committed to the earth, amidst the weeping and lamentation of a numerous train of mourners. An orator, appointed by the republic, pronounced, from an elevated spot, a funeral oration, in praise of his valiant countrymen; and each tribe raised over the graves of its members a column, or monument of some kind, upon which were inscribed the names of the deceased, their age, and the places where they had fallen. See Beloe's *Herodot.* vol. ii. p. 65. N.

Some interesting particulars, regarding the funeral ceremonies observed by other ancient nations, have been preserved by Herodotus.

Among the Egyptians, when a man of any consequence died, the females of the family disfigured their faces with dirt, left the corpse in the house, and ran publicly about, accompanied by their female relations, with their garments in disorder, their breasts exposed, and beating themselves severely. The men on their part did the same; after which the body was carried to the embalmers. Certain persons were legally appointed to the exercise of this profession, who treated the body in different modes, according to the rank and fortune of the deceased. *Herodot. Euterp.* p. 85, 86. For an account of the different methods of embalming and preserving dead bodies, see the article MUMMY.

By the ancient Ethiopian practice, which is related by Herodotus according to the traditions of Cambyses' spies, after all the moisture was extracted from the body, by the Egyptian, or some other process, they covered it entirely with a kind of plaster, which they decorated with various colours, so as to make it convey as near a resemblance as possible of the person of the deceased. They then inclosed it in a hollow pillar of crystal, which was dug up in great abundance, and of a kind that was easily wrought. The body of the deceased was very conspicuous through the crystal, had no disagreeable smell, nor any thing else that was offensive. This coffin was kept by the nearest relations of the deceased for a twelvemonth in their houses, during which period they offered before it different kinds of victims, and the first fruits of their lands. These were afterwards removed, and set up round the city. *Herodot. Thal.* 24.

The ceremonies observed at the funerals of the Scythian kings were extremely singular. As soon as the king died, a large quadrangular trench was sunk near the spot where the Borysthenes begins to be navigable. The body was then thoroughly cleansed, and embalmed with various aromatic herbs, and inclosed in wax. After being transported through the different provinces of the kingdom, the dead body was at last brought to the Gerrhi, who lived in the remotest parts of Scythia, and amongst whom the sepulchres were. Here the corpse was placed upon a couch, round which daggers were fixed at different distances; and upon the whole were disposed pieces of wood, covered with branches of willow. In some other part of the trench they buried one of the concubines of the deceased, whom they had previously strangled, together with the baker, the cook, the groom, his most confidential servant, his horses, the choicest of his effects, and some golden goblets. The trench was then filled up with earth, and a mound as high as possible raised above the whole. Such was the mode of burial adopted at the interment of their kings; but among the people, in general, the ceremony was somewhat different. When any one died, the neighbours placed the body in a carriage, and carried it about to the different acquaintance of the deceased. These prepared some entertainment for the persons who accompanied the corpse, placing before the body the same as before the rest. After being carried about, in this manner, for the space of forty days, the corpse was at length buried. The Scythians, however, do not seem to have all observed the same customs with regard to their funerals; for it would appear, that there were some who suspended the dead body from a tree, and left it there to putrefy. "Of what consequence," says Plutarch, "is it to Theodorus, whether he rots in the earth or upon it? Such among the Scythians, is the most honourable funeral." This strange custom is also mentioned by Silius Italicus:

> At gente in Scythiâ suffisca cadavera truncis
> Lenta dies sepelit, putri linquentia tabo.

A similar practice, Captain Cook observes, prevails among the inhabitants of Otaheite, who leave dead bodies to putrefy on the surface of the ground, and then bury the bones. See Herodot. *Melpomene*, 71—73. Beloe's *Transl.* vol. ii. p. 243—247. Hawksworth's *Voyages*.

The African Nomades observed, in general, the same ceremonies with the Greeks in the interment of the dead, excepting the Nasamones, who buried the corpse in a sitting attitude; and were particularly careful, when any one approached his end, to prevent his expiring in a reclined posture. Herodot. *Melp.* 190.

The ancient Persians first inclosed their dead bodies in wax, and afterwards placed them in the ground. For a long time, the Magi seem to have retained the exclusive privilege of having their bodies left as a prey to carnivorous animals. But in succeeding times, the Persians abandoned all corpses indiscriminately to birds and beasts of prey; and this custom still in part continues. The burial-place of the Guebres, about half a league from Ispahan, is a round tower made of free-stone, thirty-five feet in height, and ninety in diameter, without gate or entrance of any kind, and ascended by a ladder. In the middle of the tower is a sort of trench, into which the bones are thrown. The bodies are ranged along the wall in their proper clothes, upon a small couch, with bottles of wine, &c. The ravens which fill the cemetery devour them. (Chardin's *Travels*. Beloe's *Herodotus*, vol. i. p. 144, N.) An exact model of this curious tower is preserved in the British Museum.

The funerals of the chief men among the ancient Thracians were performed in the following manner. For the space of three days the body of the deceased was publicly exposed; then, after sacrificing animals of every description, and uttering many and loud lamentations, they celebrated a feast, and the body was finally either buried or burned. A mound of earth was afterwards raised upon the spot, and games of various kinds were celebrated, in which each particular contest had a suitable reward assinged it. *Herodot. Terps.* 8.

Among the Romans, the dead body was bathed with warm water, anointed with perfumes, and then dressed in the best robe which the deceased had worn when alive; ordinary citizens in a white *toga*, and magistrates in their *prætexta*, &c. In this state the corpse was placed on a couch in the vestibule, with the feet outwards, as if about to take its last departure. A lamentation was then made over the body, and the couch was sometimes decked with leaves and flowers, as in the case of Pallas, mentioned by Virgil, *Æneid*, 64—66. If the deceased had obtained a crown for his bravery, it was now put upon his head. A small coin (*triens vel obolus*) was put in his mouth, which he might give to Charon for his freight; for, without this, it was thought that souls could not purchase a lodging, or place of rest. The body was afterwards either buried or burnt.

The Roman funerals were either public or private; and these, again, consisted of several different kinds. When a public funeral was intended, the corpse was usually preserved for seven or eight days, with a keeper to watch it. In the case of a private funeral, the body was not kept so long. On the day of the funeral, when the people were assembled, the dead body was carried out, with the feet foremost, on a couch, which was covered with rich cloth, decorated with gold and purple, and generally supported on the shoulders of the nearest relations of the deceased, of his heirs, or his freedmen, and sometimes of persons of rank. Anciently, all funerals were celebrated at night, with torches; but, afterwards, public funerals were solemnized at an early hour of the day. Private funerals, however, always took place at night. The order of the funeral procession was regulated by a person called *designator*, attended by lictors, dressed in black. First went musicians of various kinds; then mourning women, hired to lament and to sing the funeral song, or the praises of the deceased, to the sound of the flute. The number of flute-players at a funeral was restricted to ten, by the laws of the twelve tables. Next came players and buffoons, who danced and sung; while one of them, called *Archimimus*, supported the character of the deceased, imitating his words and actions when alive. Then followed the freedmen of the deceased. Before the corpse were carried the images of the deceased, and of his ancestors, on long poles or frames. After the funeral, these images were again set up in the hall, where they were preserved. If the deceased had distinguished himself in war, the crowns and rewards which he had received for his valour were displayed, together with the spoils and standards which he had taken from the enemy. The lictors attended with their *fasces* inverted; and sometimes the officers and troops, with their spears pointing to the ground, or laid entirely aside. Behind the corpse walked the friends of the deceased in mourning; the magistrates without their badges, and the nobility without their ornaments. At the funeral of an illustrious citizen, the corpse was carried through the *forum*; where the procession stopped, and a funeral oration was pronounced in praise of the deceased from the *rostra*, by some near relation or friend, or by a magistrate. From the *forum*, it was carried to the place of burning or burial. If the corpse was to be burnt, it was placed, along with the couch, on the funeral pile; which was built in the form of an altar, with four equal sides, of such kind of wood as might easily take fire. The nearest relations kissed the body with tears, and then set fire to the pile with a lighted torch, turning away their faces to shew that they did it reluctantly. Various perfumes, &c. were thrown into the fire; and animals, especially such as the deceased had been fond of, were slaughtered at the pile, and thrown into it. When the pile was burnt down, the fire was extinguished, and the embers were soaked with wine; the bones were then gathered by the nearest relations. The bones and ashes, after having been besprinkled with the richest perfumes, were put into an urn, made of earth, brass, marble, silver or gold, according to the rank and fortune of the deceased; and along with them, sometimes, a vial full of tears, called by the moderns a *lachrymatory*. The urn was then solemnly deposited in the sepulchre.

When the body was not burnt, it was put into a coffin, usually made of stone, which was laid in the tomb on its back. Some time after the funeral, the family were occupied with the ceremonies of mourning and purification. Oblations, or sacrifices to the dead, were afterwards performed. The sepulchre was then bespread with flowers, and covered with crowns and fillets; and before it there was a little altar, on which libations were made, and incense burnt. A keeper was appointed to watch the tomb, which was frequently illuminated with lamps.

At the funerals of the emperors, and other illustrious persons, who were deified after death, the real body was burnt, and the remains buried in the usual manner. But a waxen image of the deceased was made to the life, which, after a variety of ridiculous ceremonies, was carried on a couch in solemn procession on the shoulders of young men of equestrian rank, first to the *forum*, where the dirge was sung by a choir of boys and girls of the most noble descent; then to the *campus martius*, where it was burnt, with a vast quantity of the richest perfumes, on a lofty and magnificent pile; from the top of which, an eagle, let loose, was supposed to convey the prince's soul to heaven. See Adams' *Roman Antiquities*.

A very interesting account of the funeral ceremonies observed among the Hindus, has been given us by Mr Colebrooke, in his ingenious essays "*On the Religious Ceremonies of the Hindus, and of the Brahmans especially*." (See Essay ii. *Asiatic Researches*, vol. vii.) A dying man, when no hopes of his surviving remain, should be laid upon a bed of *cusa* grass, in the open air; his head should be sprinkled with water drawn from the Ganges, and smeared with clay brought from the same river. A *Salagrama* stone should be placed near him, holy strains from the *Veda*, or from sacred poems, repeated aloud in his ears, and leaves of holy basil scattered over his head. When he expires, the body must be washed, perfumed, and decked with wreathes of flowers; a bit of *tutanag*, another of gold, a gem of some sort, and a piece of coral, should be put into the mouth of the corpse, and bits of gold in both nostrils, both eyes, and both ears. A cloth, perfumed with fragrant oil, must be thrown over the body, which is then carried, by the nearest relations, to some spot in the forest, or near water. The corpse is carried out by the southern gate of the town, if the deceased were a Sudra; by the western, if a Brahmana; by the northern, if he belonged to the military class; and by the eastern, if he sprung from the mercantile tribe. When the procession has reached its destination, the corpse must be gently laid, with the head towards the south, on a bed of *cusa*, the tips of which are pointed southward. The sons, or other relations of the deceased, having bathed in their clothes, must next prepare the funeral pile, on a clean spot of earth, after marking lines thereon, to consecrate it. They must afterwards wash the body, meditating on all the holy places on the face of the earth, as well as the four oceans. After being washed, clothed in clean apparel, and rubbed with perfumes, the relations of the deceased place the corpse supine, with its head towards the north, (or resupine, if it be the body of a woman), on the funeral pile, which is previously decorated with flowers. A cloth must then be thrown over it, and a relation of the deceased, taking up a lighted brand, after some ceremonies and invocations, applies the fire to the pile, saying, "Namo! Namah!" while the attending priests recite an appropriate prayer. They then walk in procession, according to seniority, to a river or other running water; and, after bathing, present oblations of water from the joined palms of their hands. If it be intended to show particular honour to the deceased, three offerings of water may be thus made. After finishing the usual libations of water, and shifting their wet clothes, they sit down on the soft turf, and recite certain suitable moral sentences. During ten days, funeral cakes, together with libations of water and *tila*, must be offered as on the first. On the last day of mourning, the nearest kinsman of the deceased gathers his ashes, after offering a *straddha* singly for him. After observing a variety of ceremonies, he proceeds to the spot where the pile stood, adores the divinities who preside over countries, deposits the bones of the deceased in a casket, composed of the leaves of the *Butea frondosa*, and inters them in a profound excavation. To cover the spot where the funeral pile stood, a tree should be planted, or a mound of masonry be raised, or a pond be dug, or a standard be erected. At a subsequent time, the casket is dug up, and thrown into the Ganges.

Among the Turks and other Mahometans, when any person is to be buried, it is usual to bring the corpse, at mid-day or afternoon prayers, to one of their mosques, from whence it is accompanied by the greatest part of the congregation to the grave. Their processions, upon these occasions, are not so slow and solemn as in most parts of Christendom; for the whole company make what haste they can, singing, as they go along, some select passages from the Koran. That absolute submission which they pay to the will of God, allows them not to use any consolatory words upon such occasions; no loss or misfortune is to be regretted or complained of: and instead of such expressions of sorrow and condolence, as may regard the deceased, compliments are paid to the person who is the nearest concerned. The cemeteries of the Turks are commonly planted with cypress trees; and for the space of two or three months after any person is interred, the female relations of the deceased go once a week to weep over the grave, and deck it with flowers and green leaves. Shaw's *Travels*.

A very full account of a Mahometan funeral is given by M. Guys, in his *Lettres sur la Grece*; and another by a later traveller, Dr Griffiths, in his *Travels in Europe, Asia Minor, and Arabia*.

The funerals of the Persians are conducted in a manner similar to those in other Mahometan countries. They are, however, strangely superstitious about the burial of their kings. For, fearing lest by some magical art, any enchantments should be practised upon their bodies to the prejudice of their children, they conceal, as much as possible, the real place of interment. For this purpose, they send to different places several coffins of lead, with others of wood, and bury all alike with the same magnificence. In this manner they delude the curiosity of the people, who cannot discern, by the outside, in which of the coffins the real body should be. See *Chardin*.

The Russians, who profess the religion of the Greek church, entertain many fantastic notions with regard to the state of departed souls; and their funeral ceremonies are therefore attended with some singularities. After the dead body is dressed, a priest is hired to pray for his soul, to purify it with incense, and to sprinkle it with holy water while it remains above ground; which, among the better sort of people, it generally does for the space of eight or ten days. When the body is carried to the grave, which is done with many gesticulations of sorrow, the priest produces a ticket, signed by the bishop and another clergyman, as the deceased's passport to heaven. When this is put into the coffin, between the fingers of the corpse, the company return to the deceased's house, where they drown their sorrow in intoxication, which is sometimes prolonged for a considerable period.—During that time, a priest says prayers every day over the grave; for though the Russians do not believe in purgatory, yet they imagine that their departed friend may be assisted by prayer in his long journey to the place of his destination after this life.

In Japan, Peru, Pegu, Mexico, Tartary, and Siam, the dead are burned; and in the case of persons of superior rank and consideration, the fires are made with aromatic woods, gums, balsams, and oils. In China, it is said to have been formerly the custom to bury slaves with the emperors and princes; but this cruel practice has given way, in modern times, to the more innocent one of burning images of their domestics in tin-foil, cut into the shape of human beings, and of placing their statues in wood or stone upon the graves. The last remains of a relation are interred with all the honours which the family can afford. See Barrow's *Travels in China*.

Among the Hottentots, the dead are interred with very little ceremony. When a Hottentot dies, he is buried in his worst dress, (a sort of mantle made of sheep's or calf's skin), and the limbs are disposed in such a manner that the whole body is covered. The corpse is then carried by the relations to a certain distance from the horde, and thrust into a pit or hole, dug for the purpose, and then covered over with earth, stones, or brushwood. Such a mausoleum, however, proves but a very weak defence against the attacks of the jackal and hyæna, which generally dig up and devour the body. A horrid custom is said to prevail among these savages, of burying children at the breast alive, in case of the mothers's death. See Vaillant's *Travels*; Sparrman's *Voyage*.

In New South Wales, the dead are burned, afterwards deposited in the ground, and a mound or hillock raised upon the ashes. (Hunter's *Voyage*.) At Otaheite, none are burned in the *Morai* but those offered in sacrifice, or slain in battle, or the children of chiefs which have been strangled at the birth; an act of atrocious inhumanity, which is too common among those islanders. When a person of eminence dies, the body is preserved, and not buried, unless he died of some contagious or offensive disease. The following is understood to be the method in which this preservation is effected. Soon after death, the body is disembowelled, and the cavity is then filled or stuffed with cloth. When any moisture appears on the skin, it is carefully dried up, and the body afterwards rubbed all over with a large quantity of perfumed oil; which being frequently repeated, preserves it a great many months; but, at last, it gradually moulders away. The relations and friends, who are absent, perform their part of the feneral rites at their arrival; each female presenting a piece of cloth to the corpse; and they continue to dress and decorate the body, as if still alive, and to furnish it with provisions, supposing that the soul which hovers round receives satisfaction from such marks of attention. See Cook's *Voyages*.

Among the antient Britons, both cremation and interment were practised, as druidical rites. When a dead body was interred, it was usual to bury along with it whatever was of use in this life, under the superstitious notion that the deceased would have occasion for it in the other world. Hence, arms and various other utensils are still discovered in old tombs. The practice of raising barrows over the bodies of the deceased, which was almost universal in the earlier ages of the world, prevailed also among the Britons. Beneath these barrows both arms and skeletons are frequently discovered: (See BARROW.) At what precise period the use of coffins was introduced into this country, has not been ascertained; but in its rudest form, the *kist-vaen*, or coffin composed of rough stones set edgewise at the sides and ends, appears to have been a very ancient receptacle of the dead in Britain. The great improvement of the stone coffin, by forming it of a single stone, with mallet and tool, has been ascribed to the Romans; who appear, however, to have made use of brick coffins, or *sarcophagi*, in their earliest periods. The practice of cremation ceased upon the introduction of Christianity; and the Britons, after the example of the Romans, had recourse to interment and the use of coffins. See Gough's *Sepul. Monum*; Pennant's *Tour in Wales*; Stukely's *Abury*; *Archæol.* vol. ii.

3. In ancient times, it does not appear that any thing was determined particularly with regard to the place of burying the dead. There were graves in the town and country, upon the highways, in gardens, and on mountains. The tombs of the king's of Judah were in Jerusalem, and in the royal gardens. The sepulchre which Joseph of Arimathea had provided for himself, and wherein he placed our Saviour's body, was in his garden; that of Rachel was upon the highway from Jerusalem to Bethlehem. The kings of Israel had their burying places in Samaria; Samuel and Joab were interred in their own houses; Moses, Aaron, Eleazer, and Joshua, in mountains; King Saul and Deborah under trees; Manasseh and Amon in the garden of Uzza. The sepulchres of the people of Jerusalem are said to have been in the valley of Kidron, where were likewise the burying places for foreigners. See Calmet's *Dictionary of the Bible*, v. BURIAL.

Both the Jews and Heathens usually buried their dead without the city. By a law of the twelve tables, the Romans were prohibited from burying within the city: *Hominem mortuum in urbe ne sepelito, neve urito.* Cic. *De Leg.* ii. 23. But a special privilege was sometimes granted by the senate to particular persons, that they might be buried within the walls; as in the case of Julius Cæsar, who obtained the right of making a sepulchre for himself within the *Pomærium*. Other illustrious families likewise possessed the privilege of being interred within the walls; and the vestal virgins were always buried in the city. The burial places among the Romans were either private or public. The former were in fields or gardens, generally near the highway: hence the frequent inscriptions, *Siste viator*, *Aspice viator*, &c. on the *Via Appia*, *Aurelia Flaminia*, &c. The public places of interment for great men were commonly in the *Campus Martius*, or *Campus Esquilinus*, which were granted by a decree of the senate; and for poor people, without the Esquiline gate, in pits or holes dug perpendicularly, called *puticulæ* The tombs of the rich were generally built of marble, the ground inclosed with a wall, or iron rail, and planted round with trees. Common sepulchres were usually built below ground, many of which still exist in Italy under the name of catacombs. See Adams' *Roman Antiq.*

The Greeks, in general, followed the same practice of burying without the city walls. Lycurgus, however, introduced the contrary practice among the Lacadæmonians, with the view, it is said, of rendering the youth of Sparta familiar with the spectacle of death.

The Turks, we are told, bury not at all within the walls of the city, excepting the great Turkish emperors, with their wives and children, and some few other of their great Bassaes, and those only in chapels by themselves built for that purpose. All the rest of the Turks are buried in the fields; some of the better sort in tombs of marble; but the rest with tomb-stones laid upon them, or with two great stones, one at the head, and the other at the foot of every grave. The greatest part of these are of white marble brought from the Isle of Marmora (Knolles' *Hist. of the Turks.*) They are in the habit of burying by the way-side, believing that passengers will pray for the souls of the dead. Tavernier's *Travels*.

Among the primitive Christians, burying in cities was not permitted for the first 300 years, nor in churches for many ages afterwards; the bodies of the dead being first deposited in the church-yard, and porches and porticoes of the church. Upon the introduction of Christianity into this country, a regular mode of disposing of dead bodies took place. The people, during worship, were taught to look towards the altar, and the dead were buried with their faces the same way, excepting the priests, who, for a similar reason, were ordered to face the congregation. The reason given by Gregory the Great, for the custom of burying in churches, or in places adjoining to them, was, that the tombs of the dead might recall them to the recollection of their friends and relations, who might thus be led to offer up prayers for them; and this reason was afterwards transferred into the body of the canon law. Hence also the striking and solemn address which distinguished the epitaphs of the monkish ages: *Orate pro anima miserrimi peccatoris.* In the eighth century, the people began to be admitted into the church-yards, and some princes and distinguished persons into the church. The practice, first introduced into the Romish church by Gregory the Great, was brought into England by Cuthbert, archbishop of Canterbury, about the year 750; and the custom of erecting vaults in chancels, and under the altars, was commenced by Lanfranc, archbishop of Canterbury, when he had rebuilt the cathedral there, about 1075.

4. By the common law of England, the granting of burial within the church is the exclusive privilege of the incumbent; excepting those cases where a place of burial is prescribed for, as belonging to a manor-house. The church wardens, however, have by custom a fee for every burial there, because the parish is at the expence of repairing the floor. Watson's *Clergyman's Law*.

The 68th canon of the church enjoins, that "no minister shall refuse to bury any corpse that is brought to the church, or church-yard, (convenient warning being given him thereof before,) except the party deceased were denounced excommunicated, *majori excommunicatione*, for some grievous and notorious crime, and no man able to testify of his repentance." Anciently, there were other causes of refusal, particularly in the case of heretics, against whom there was an especial provision in the canon law, that if they continued in their heresy, they should not enjoy the privilege of Christian burial; but no instances of its enforcement occur subsequent to the period of the Reformation. Such as had not received the holy sacrament, at least at Easter, were excluded from Christian burial, by a law of the Lateran council, which was afterwards adopted by the English church. But all these and other prohibitions are, at this day, considered as obsolete, and the denial of burial is restrained to the excommunicated, the unbaptized, and suicides.

A case occurred lately in England, in which the denial of burial was attempted to be enforced against dissenters from the established church. The Rev. John Wight Wickes, rector of Wardly-cum-Belton, refused to bury the infant child of two of his parishioners, who were Calvinistic Independents, because it had not received Episcopalian baptism. A suit was brought against this clergyman in the Arches Court of Canterbury, for violating the 68th canon above quoted, in which Sir J. Nicholl, official principal of that court, gave judgment for the plaintiff, chiefly upon the ground, that the church of England had recognized persons, though not baptized in its own forms, yet as validly baptized; and that it could not mean to exclude from burial all persons who have not been baptized according to the forms of its own liturgy, provided the essence of baptism, according to what has been generally received as such among Christians, has taken place; but those only who have not been baptized at all by any form which can be recognized as an initiation,—a legal and valid initiation into the Christian church. This judgment has given rise to some controversy; for the substance and merits of which we must refer our readers to the decision of Sir J. Nicholl, with the reasons for it, published by Mr Gurney; the *Respectful Examination of the Judgment*, &c. by the Rev. Charles Daubeny, LL.B. archdeacon of Sarum, Bath, 1811; and the *Review of Archdeacon Daubeny's Examination*, in the *Edinburgh Christian Instructor* for October 1811.

The statute 30th Car. II. c. 3. for the encouragement of the woollen manufactures, enacts, that no corpse shall be buried in any other stuff than what is made of sheep's wool, on pain of forfeiting 5*l*. And an affidavit is to be made of such burying before a magistrate, or the officiating minister. Jacob's *Law Dict.* (*z*)

BURKE, Edmund, a writer distinguished in morals, criticism, and politics, was born in Dublin on the 1st of January 1730. His father was a reputable attorney, and not a Catholic, as has been sometimes asserted. He was educated in the academy of Shackleton by a quaker at Ballystore, near Carlow, to whom for 40 years, during his visits to Ireland, the grateful scholar used regularly to pay his respects. In 1746, he was entered at Dublin College, where he pursued a wide and diversified course of studies, chiefly in moral science, and took a bachelor's degree. The story of his studying at St Omer's is denied, apparently on good grounds, by his biographers. We hear, however, nothing farther about him, till he made an unsuccessful attempt for the vacant professorship of logic at the college of Glasgow. Burke, it is said, was passing the old college court gate of that place, when a label affixed to it struck his eye, which had been pasted up as a mere matter of form, inviting all candidates for the professorship to compete, although it was known that a successor was already fixed upon. Whether Burke made a public competition by the old syllogistic mode, or was at all a competitor in form, we know not. In 1753, he came to London, and fixed as a student of law; and for some time, there is every reason to believe, supported himself by writing for newspapers and magazines. Yet, though hitherto comparatively obscure, he found his way to polite society, distinguished himself wherever he was known by the charms of his conversation, and was so far a man of pleasure, as to be supposed to be on intimate terms of friendship with Mrs Wollington, the actress, whose elegance of manners was to him like that of Aspasia to Socrates, and contributed a polish to the solid materials of his mind. A decline of his health made him the guest of his friend Dr Nugent, which eventually occasioned his marriage with the daughter of that able physician.

His first avowed work appeared in 1756, *A Vindication of Natural Society, or a view of the miseries and evils arising to mankind from every species of artificial society*; in a letter to Lord * * *, by a late noble writer. The noble writer meant to be supposed was Lord Bolingbroke Whether Mr Burke's real intention in this work was to represent the worst errors of human institutions, or ironically to shew the weakness of Bolingbroke's arguments against religion founded on its abuses, by pointing the same inconclusive arguments against civil institutions, we know not; but his work attracted, at its first appearance, very little interest. The reception of his *Essay on the Sublime and Beautiful*, in 1757, was much more flattering; and has since preserved his name among the highest writers on the philosophy of taste; although the errors of much of his system have been since sufficiently refuted. The fame of this work is said to have procured him the acquaintance of Reynolds and Johnson. Such, however, was the force of Burke's mind in conversation, and such was his promptitude in bringing it to bear on all present points, that we doubt if his introduction to the highest literary circle of his time was owing to his writings. A man who could not be conversed with, (as Johnson said,) while you took shelter with him from a shower under a gateway, without perceiving that he was an extraordinary genius, such a man required no treatises to introduce him in any circle. In 1758, he proposed to Dodsley the bookseller, the plan of the Annual Register. He wrote much of the historical part of that work: the general air of which has a candour and a diffuse dignity resembling the unpremeditated effusions of such a mind as his. His political career may be said to have commenced in 1761, when, going over as confidential friend to Mr (Single Speech) Hamilton, secretary to the Lord Lieutenant Lord Halifax, he is supposed to have rendered some service to the ministry, for which they rewarded him with a pension of 300*l*. a year on the Irish establishment. Soon after his return to London, he was introduced to Lord Rockingham, who made him his private secretary, gave him a loan, or rather a present, of several thousand pounds, and, by his personal kindness and congenial patriotism, gave a colour to the politics of Burke, which they retained with few variations during life. He was, indeed, at different periods, both a democrat and an aristocrat; but he combined, during the greater part of his life, a certain visible connection between the apparently incongruous qualities of those distinctions. He loved the liberty of England, but he wished the moving power of the government to centre in the great families. These were the politics of Rockingham. Burke stood up for America against the claim of taxation; but he wished to wave the question of abstract right.—This was the practice of Rockingham. By Lord Rockingham's bounty, he was enabled to purchase his seat at Beaconsfield; by the interest of his patron he also got into parliament. His first speech excited uncommon sensation; more admiration, perhaps, of his eloquence than of his logic; but when superior powers of imagination are displayed, the mass of mankind look sanguinely for the further evolution of practical and solid talents. Burke now partakes the blame of what are called the indecisive measures of the Rockingham cabinet with respect to America; but he shared at the time in the popularity of the repeals of the cyder and warrant acts. The administration of Lord Rockingham was short, and Burke concluded his official labours by a forcible and (considering the style of his eloquence) a simple work, entitled *A short account of a late short Administration.* After which he took his station among the determined opposers of ministry, and the regular censurers of their proceedings. In his next political work, his *Thoughts on the Causes of the present Discontents*, while he asserts the most popular principles of the constitution, he reverts to a practical remedy, which attests his leaning to aristocracy; for the sum of his arguments is, that the government ought to be placed in the hands of the great Whig families, who had been favourers of the Revolution, and of its consequent measures. The same gist of argument is liberally strewn over the speeches of Chatham himself, although the popularity of that nobleman prevented the nation from interpreting the meaning of his free advice to his sovereign, when he told him that he could not hope to act by *any* minister without the aid of the powerful families of England: There might be practical truth, but there was little democracy in this sentiment.

During his opposition to the American war, Burke was certainly at an elevation of just favour, sufficient, perhaps, to be a zenith to the fame of any man but himself. A pacific adjustment of the differences between the mother country and America, when affairs had gone so far, might have admitted of principles more permanently decisive than *his*, but they admitted of none more adapted to save the dignity or prejudices of Britain. For a *lasting* reconciliation, the abandonment of the right of taxation might have been advisable; but for immediate truce, which ought to have led to reconcilement, the abandonment of *the question* of right was better suited; or, perhaps, even an indistinct recognizance of it. But the blundering hands which succeeded the short Rockingham administration did not do justice to the mildly temporizing policy of that amiable cabinet. The American war at last became popular.—Now it is fashionable to lay the blame of it on Grenville and North.—A murderer might, with equal justice, blame the sword, with which he has killed an innocent man, as the British people accuse their ministers—their servants—with the criminality of a war, in the events of which they not only partook, but sympathized in every fibre of their hearts. If we do not recollect from our own memories, our fathers have told us, that Washington was burnt in effigy in England, and would have been *hanged* in reality amidst the applauses of millions, if he *could have been laid hold of*.

In March 178[illegible], an end was put to the ministry of Lord North; and on the return of the Marquis of Rockingham to power, Burke became paymaster of the forces, and had a seat at the council-board. The death of Lord Rockingham effectively dissolved the ministry, and on the appointment of Lord Shelburne, Mr Burke, with many of the Duke of Portland's friends, resigned. After the peace, he had a leading share in the formation of the coalition, which gave a shock to the public ideas of political consistency beyond what either the enlarged mind of Fox, or the more accommodating ideas of Burke, had room to anticipate. Mr Pitt, by seizing on the happy moment when both king and people were on bad terms with the ministry, turned them out, and withstood minorities in the House of Commons till that house presented him with majorities. In 1785, Burke seems to have taken a sufficiently independent ground, in differing at once with the minister and with the leaders of the opposition respecting the reform bill of Mr Pitt. Such a conduct was consistent enough with his ideas of ruling by great families, and preserving the borough influence in the hands of a few nobles. His impeachment of Warren Hastings, was one of the next and most important events of his life. For even the outline of so complex a trial, we have not limits. On this subject, the majority of commonly enlightened readers are as completely undecided, or at least incompetent to be decided in their opinion, as on the most abstruse problem in science; for in fact, the *Principia* of Newton might be studied in less time than the real substance of the trial of Hastings. Many men, however, as we believe, unbiassed in the question, have, after laborious attention to it, made up their opinion, that whatever were the oppressions perpetrated in India, Britain, and not Hastings, was responsible for them. All the conduct of Burke, which forms the external avenues to the question, gives, as far as that goes, a sanction to this opinion. He was violent, bitter, and full of ostentation. In the moment of Hasting's hesitation about the ceremony of kneeling at the bar, an hesitation proceeding from accident, he commanded him to kneel, with a ferocity in his countenance which no painting could express. He marched at the head of the managers of the indictment, with an air of pompous elatement; and, in fine, it is evident, that he had Cicero against Verres incessantly in his eye during all his rhetorical appearances on this subject.

In the settling of the regency, on the king's illness in 1788, he took a warm and active part. His appearances on this subject always gave more alarm to the opposition than the minister. In the short period that elapsed between this question and the French revolution, there were no party circumstances of which we know that could alienate him from the opposition (for his jealousy of Sheridan is not an idea consistent with the bulk or frame of his mind,) so that his sentiments on the French revolution could not be supposed to be connected with personal pique, and the general tone of his character forbids the suspicion of his having been corrupted. His principles had been before more than suspiciously aristocratic on very important occasions, and there was nothing in the French revolution, as it proceeded, to conciliate the affections of a mind imbued with such a bias, unless the observer had lived to read the court calendar of Bonaparte.

His abhorrence to the French revolution preceded the worst acts of that event; and though, like every evil wisher to change, Mr Burke predicted as many atrocities as took place, yet we must hesitate in pronouncing those warnings to have been uttered in the spirit of prophetic wisdom; for he foretold many things directly the reverse of what happened. Among these was his prediction, that France "would be blotted out from the map of Europe." As early as the beginning of the year 1790, he spoke his sentiments with plainness and warmth in the House of Commons, in which he renounced friendship with Mr Fox, and all who cherished sentiments like *his* on the same principles and subject. From that time he busied himself in his memorable work on the French Revolution, a work which commenced a war of the press on the great principles of government, evoking greater polemical talents in writing than had been displayed since the pamphlets of Milton and Salmasius. It was answered at home by Mackintosh and others, and abroad by Paine. The coarse, but popular, eloquence of the last writer could not indeed be compared with the philosophical spirit of the British writers; but it struck lower at the root of common opinion, and produced effects we all remember how serious. By his enemies, the work of Burke was described as a blaze of rhetoric around a nucleus of false principles and sophistry. The majority of the nation, of that part at least whose property gave influence in the country, did not think so; and his opinions certainly gave a decided bias to the warlike measures of the cabinet. His second attack on the revolution, in a letter to a member of the French National Assembly, was made in 1791, when affairs were yet assuming a deeper horror to the revolution, and gave an air of secure triumph to his exposition of principles not essentially connected with its errors. His Appeal from the New Whigs to the Old; his Letter to a noble Lord on the subject in discussion with the Duke of Bedford; and his Thoughts on a Regicide Peace, attested his enflamed and increasing zeal on the subject of his great political passion.

It was objected by his enemies, that his zeal was not uninvigorated by royal bounty. His hospitality and personal generosity, had always made him a needy man. He entertained an aristocratical opinion, long and frequently expressed before he depended for his main support on the pensions of his sovereign, that a man of first-rate abilities had a right to be supported at the public expence. Confined to such genius as Burke's, this doctrine might be safely admitted by the austerest republican; and few, we believe, of his political enemies, would rest it as a serious charge against his memory, that he supported the close of so illustrious a life on the kindness of royal patronage. He who could grudge the pension of Burke, is surely unworthy to be his reader or his countryman.

The close of his political career was marked by an honourable attachment to the cause of the emancipation of the Irish Catholics, which he expressed and enforced in a letter to Sir Hercules Langrishe, written in 1792. He withdrew from parliament in 1794, and his seat for New Malton was occupied by his only son, whom he viewed with all the partiality of paternal admiration. The death of that son precipitated the decline of nature, which he was already beginning to feel. After his death, Burke lived only to die; such was the expression used in describing the effect of this event on his mind, by the Irish orator Grattan, in the hearing of the writer of this article, when the great subject of this biography happened to be the topic of conversation in company. He expired in his 68th year, on the 8th of July, 1797.

He was amiable and exemplary in his domestic relations, elegant in his taste, and benevolent in his intentions. Few men have performed greater services to the public, and none have filled, during their lives, a greater space in the public eye. (*z*)

BURLESQUE. See POETRY.

BURLINGTON, a county of North America, in the state of New Jersey, lies between the Delaware river and the Atlantic ocean, and extends about 60 miles in length, and 30 in breadth. This county is in general level and well watered; and, out of 250,025 acres, 194,600 are in an improved state. It contains 11 townships, 15,500 white, and 520 black inhabitants; of which last, 53 are slaves; and furnishes 3000 militia. Its principal towns are Burlington and Bordentown. (*p*)

BURLINGTON, a town of New Jersey, and capital of the county of Burlington, extends three miles along the east bank of the Delaware, and was first settled in 1677. The most populous part of the town is built upon an island, about a mile and a quarter long, and three quarters of a mile broad, which communicates with the mainland by four bridges or causeways. The principal streets are regular and spacious, and ornamented with rows of trees in front of the houses. It has an Episcopal chapel, a Quaker meeting-house, an academy, and a free school; which last is supported by the profits arising from the island of Matinicunk, which amount yearly to [illegible]. It has also a court-house, two market-houses, and the best jail in the state. Burlington is a free port, and possesses a very commodious harbour; but its vicinity to Philadelphia renders these advantages of little consequence. In the island are [illegible] houses, and about 1000 inhabitants, of which above 100 are negroes. North latitude 40° 5'. West longitude [illegible]. See Morse's *American Geography*, p. 399. (*p*)

BURMANNIA, a genus of plants of the class Hexandria and order Monogynia. See BOTANY, p. 177.

BURN. See SURGERY.

BURNET, THOMAS, according to the general opinion, founded on an inadvertent expression of Anthony Wood, was born in Scotland; but it appears, from the more respectable authority of Birch's *Life of Tillotson*, that his native place was Croft in Yorkshire. At the grammar school of North Alverton he made great proficiency, and was often held up by his master as an example to the rest of the scholars. In 1651, he was admitted of Clare-hall in Cambridge, where he had for his tutor Mr Tillotson, who was afterwards archbishop of Canterbury; and, in 1654, he went to Christ College, of which the learned Dr Cudworth had obtained the mastership. In 1657, he was chosen fellow of that house. In 1658, he took the degree of A. M.; and, in 1661, was chosen senior proctor of the university. He travelled for some time with the Earl of Wiltshire; and, besides this, was governor to Charles, Duke of Bolton, and to James, Earl of Ossory, who was grandson to James, the first Duke of Ormond. Through the patronage and influence of the Duke, he was chosen master of the charter-house in London, and soon after took orders in the church. While in that situation, he distinguished himself by opposing, with equal vigour and success, an attempt on the part of James II to place one Andrew Popham, a Papist, as a pensioner on the charter-house foundation. The other governors, with the exception of Chancellor Jefferys, supported him in this bold measure; and the monarch, meeting with such determined resistance, abandoned his purpose. In 1680, he published his *Telluris Theoria Sacra*, a work which was much celebrated in its day, but has long since given place to new speculations, more accordant to the phenomena of nature, though equally insufficient to account for them all. It received high applause from several authors of repute, particularly from Bayle (Letter to L'Enfant), *The Spectator* (No. 146), and Mr Addison individually, who indited a fine Latin ode on the occasion; and it must be allowed to have a just claim to the praise of great learning, ingenious disquisition, and elegant latinity. But it is very extravagant in some things, very unsound in others, and, upon the whole, amounts to little more than a beautiful geological romance. In point both of philosophy and religion, it has been deemed highly objectionable; and it no sooner made its appearance, than it was answered and condemned in various pamphlets, to which the author replied with ability. Among many others, Mr Keill the mathematician, in an examination of the theory, pointed out its inconsistencies as a work of science; and Herbert Crofts, Bishop of Hereford, animadverted with great keenness on its heterodox and anti-scriptural principles. Some very judicious and candid remarks on the merits of this theory, are to be found in Dr Wallace's *Various Prospects of Mankind*, *Nature, and Providence.* After the revolution, Dr Burnet was appointed chaplain in ordinary to King William. He was also, through the interest of Archbishop Tillotson, appointed clerk of the closet to that prince. But from this place he was removed in 1692, on account, it is said with some appearance of probability, of the offence which he had given to the clergy by the publication of his *Archæologiæ Philosophicæ.* That work, indeed, was by no means orthodox. It called in question the literal history of the fall; and contained an imaginary dialogue between Eve and the serpent, so extremely objectionable, that the author himself, who was sufficiently firm and opinionative in other cases, was very solicitous to have it suppressed in the subsequent editions of his book. It was understood, that this circumstance, along with the general suspicion entertained of his religious sentiments, produced a combination among the superior clergy to prevent him from obtaining that preferment in the church, which, through the friendship of Tillotson, and the favour of King William, he might otherwise have expected to receive. So sceptical, indeed, was he accounted, and so strong was the prejudice against him, that all thoughts of his promotion were laid aside. He died in the year 1715. After his death, two posthumous treatises were published. The one was entitled *De fide et Officiis Christianorum,* in which he endeavours to give a compend of the doctrines and duties of Christianity, excluding what appears to him to be doubtful or unimportant, and insisting only on what he conceives to be of essential moment in both. This plan, it is evident, is liable to great abuse, and could not be very fairly executed by a man, who, like Dr Burnet, considered rather what should be, than what actually is, in the Christian revelation. The other treatise was entitled *De Statu Mortuorum et Resurgentium.* The leading point which he here maintains is, that the future punishment of the wicked is to be but temporary, and to terminate in salvation. Of this doctrine, which has been more taught by sentimental philosophers than by scriptural divines, the author perceived the dangerous consequences; and fearful, if not certain, that it would materially injure the interests of virtue among the bulk of mankind, he earnestly protested, in a note, against its being translated. The caution, however, was despised; for Dennis translated not only the book which contained the doctrine, but the note also in which its immoral tendency was acknowledged. Besides the productions already mentioned, it was discovered, after Dr Burnet's decease, that he had written three tracts against Locke's *Essay concerning Human Understanding,* the first of which was animadverted upon by Locke himself, and all of which were answered by Mrs Cockburn in her able defence of that celebrated essay. See *Biographia Britannica;* Birch's *Life of Tillotson;* and the *Life of Dr Thomas Burnet,* prefixed to the translation of the *Archæologiæ.* (*r*)

BURNET, Gilbert, Bishop of Sarum, was born at Edinburgh in 1643. His father, who was a Lord of Session under the title of Lord Crimond, and a younger son of the family of Leys in Kincardineshire, was attached to the Episcopalian, his mother to the Presbyterian, discipline; a circumstance which perhaps contributed to the liberality with which he always regarded lesser religious differences. At the age of 14, he commenced master of arts in the college of Aberdeen; and, having abandoned his original study of the civil law, he became probationary preacher when about 18. His rejection of a good living at that age, from a doubt of his competency to the charge, was a promising indication of the integrity of his future life. Having spent about three more years in theological studies in Scotland, and in visits to the English universities, he passed over to the Continent, and made some stay at Amsterdam and Paris. The year following, he returned to his native country—received priest's orders from the Bishop of Edinburgh—and was presented to the living of Saltoun, where he read the liturgy of the English church. When not more than 23 years of age, he ventured to draw up a memorial of the abuses practised by the Scotch bishops, which he defended with such success, that Archbishop Sharp thought fit to abandon his design of punishing him for his uncourtly remonstrance by deprivation and excommunication. Three years after, he was appointed professor of divinity in the university of Glasgow, and conducted himself with such moderation to the Conformists and Non-conformists, as to gain the censure of bigots of both classes.

A Scotch bishopric was twice offered him about this time, which he judged it prudent to refuse. He published, however, in 1672, *A Vindication of the Authority, Constitution, and Laws of the Church and State of Scotland,* which was dedicated to the Earl of Lauderdale; and the principles of which very well accorded with that nobleman's well-known zeal on the side of prerogative and power. On his visiting London in 1673, he was appointed one of the king's chaplains in ordinary, and appeared to be in the high road of preferment; but, for the present, his strong attachment to the Protestant cause was in the way of his ambition, and he was too honest a man to sacrifice principle to promotion. He soon lost the friendship of Lord Lauderdale; and having resigned the professorship at Glasgow, and removed to London, he was presently struck out of the list of chaplains to the king. Being now freed from the shackles of court-connexion, Burnet devoted himself, with his characteristic assiduity and zeal, to the service of his country, by resistance to the Catholic encroachments. With this view, he published, in 1679, the first volume of his *History of the Reformation in England*—a production of labour and authority, to which the state of the times added so much of incidental value, that a vote of thanks to the author passed both houses of parliament, accompanied with a request that he would complete the design. The second volume appeared two years after; and a third, which is supplementary, not till the year 1714. Burnet, both from disposition and on principle, was inclined to moderate measures; and proposed, at a time in which the public mind was violently agitated by the Popish plot, that some measure of compromise should be attempted, instead of so harsh a proceeding as the exclusion of the Duke of York from the succession. Notwithstanding this conciliatory proposal, his connection, particularly with Lord Russell, his publications, and his undisguised warmth of attachment to the Protestant interest, rendered him so obnoxious to the king and his friends, that, in 1683, he prudently determined to retire to Paris. The following year, he was discharged, by the king's order, from his lectureship at St Clement's; and on the accession of James, he became, for some time, a resident in Paris. At length, after having made the tour of Italy, Switzerland, and the south of France, by the invitation of the Prince and Princess of Orange he settled at the Hague, and obtained naturalization. Having lost his first wife, Lady Margaret Kennedy, daughter of the Earl of Cassilis, he now married a Dutch lady of fortune, descended from the Scotts of Buccleugh in Scotland. The widow Berkeley was his third wife, whom he married in 1698.

The Prince of Orange was too good a politician not to see, that the principles, talents, connections, and reputation of Burnet, all conspired to make him a valuable auxiliary to his cause, if he once espoused it warm. He therefore did not hesitate to refuse the surrender of him to the English government when it was formally demanded he should be delivered up; and in the progress of the preparations for the great enterprise which placed William on the throne of England, his experience of the fidelity and services of Burnet induced him to nominate him his chaplain, in which capacity he accompanied him in the expedition to England. On the successful issue of that great design, Burnet found himself in the road to promotion, without any obstacle, either from principle or feeling. His well-known moderation suited the temper of the present government, and both his public services and private worth recommended him to ecclesiastical elevation. In 1689 he was raised to the see of Sarum, the duties of which he discharged in a manner the most exemplary, devoting himself to the labours of the pulpit and of the diocese, with a zeal and assiduity which have rarely been equalled, and never surpassed. An institution of a nursery of students in divinity at Salisbury, under his own immediate inspection, shewed how great was his anxiety to secure a pious and enlightened clergy. He was, however, induced to abandon that favourite project, on being informed that it was regarded as a censure on the universities.

It is a singular fact, that in a pastoral letter to his clergy, the bishop maintained the right of William and Mary to the crown on the ground of conquest. But his aversion to Popery, and his zeal for the Protestant succession, were so great, that to his mind, conquest was a better title in a Protestant, than possession in a Papist. It is rather more extraordinary, that the celebrated philosophical and sceptical writer, Charles Blount, should have maintained the same doctrine in a pamphlet, entitled *King William and Queen Mary, Conquerors.* Three years after the publication of the pastoral letter, it was ordered by Parliament to be burnt, together with Blount's pamphlet, by the hands of the common hangman.

Besides a number of minor productions, Burnet published *An Exposition of the Thirty-nine Articles of the Church of England*, a work which ranks with the theological treatises of that nature. He also left for publication after his decease, *The History of his own Times, with an Account of his Life*, which was published by his son Thomas, in two volumes folio, in the years 1723 and 1734. This work, with all its defects and redundancies of style and matter, is valuable as a collection of authentic memoirs of persons, whose names are connected with some of the most important events in English history; and it is not rendered the less interesting to most readers, by the garrulity and egotism which it often displays, but which always exhibit the writer as a man of simplicity, integrity, and considerable parts, a great part of whose life was passed in intimacy with men of rank and genius, and who himself sustained a very important and honourable part in the great transactions of the day.

Many anecdotes respecting him are in ordinary circulation, some of little interest, and others of little authority. He has himself left a record of his instrumentality in the conversion of the Earl of Rochester, in his published account of the life and death of that nobleman. Of the genuineness and saving efficacy of his faith and repentance, he appears to have received a full conviction, more honourable to his heart than his judgment. It is also certain that a visit which he made to Mrs Roberts, a mistress of the king, in her last moments, suggested to him the propriety or duty, as he supposed, of addressing a monitory and expostulatory letter to Charles II. on the vices of his life and errors of his government. It is said the king gave it a second perusal before he threw it into the fire, but that he never forgave the writer. The life of this honest man and exemplary prelate was terminated by a pleuretic fever, March 17, 1715, in the 72d year of his age. See Burnet's *History of His own Times*, and *Biographia Britannica.* (J. M.)

BURNETT, the Honourable James, a senator of the college of justice in Scotland, by the title of Lord Monboddo, was descended from the ancient family of Burnett in Kincardineshire, who have possessed the domains of Leys, on Deeside, ever since the days of Robert the Bruce; and upon whom that monarch conferred the hereditary office of *forester of Mar*, accompanying the nomination with an ivory hunting-horn of very ancient workmanship. This symbol of office, suspended by a white satin sash, is still preserved in the venerable and gothic mansion of Crathes Castle, and forms a conspicuous part of the family arms, which are not unappropriately supported by a Highlander and a Greyhound. James Burnett, the great grandfather of Lord Monboddo, was a grandson of Leys by a younger son of that family and the heiress of Craigmyle; and married Elizabeth, daughter of Captain Robert Irvine, of the family of Kingcaussie. Besides other properties, which were sold by his grandson, this gentleman acquired the estates of Lagavin and Monboddo, which still remain in the family, and are at present possessed by Mr Burnett, who married Helen, the only surviving issue of Lord Monboddo. His Lordship's grandfather married his cousin, Margaret, a daughter of Sir Thomas Burnett of Leys; and his mother was a daughter of Sir William Forbes of Craigievar.* The subject of the present article was born at the family mansion of Monboddo, in the parish of Fordoun, in the end of October 1714. Of his early age, little is now remembered. From the parish school of Laurencekirk he went to King's College, Aberdeen, where he was distinguished as a young man of excellent parts, and where he imbibed that taste for Greek literature which he retained through life. Having finished the usual course of study in this university, he embarked for Holland, as was the fashion in these days, to study civil law. At Groningen he continued three years; and it has been remarked, that, during his residence in that country, he entirely lost his provincial Scotch dialect, and, from associating with some English gentlemen following the same pursuits, and some Protestant French refugees, he acquired a correct pronunciation of the French and English languages. On returning to his native country, he arrived in Edinburgh on the memorable night when Captain Porteous, of the city guard, fell a victim to the tumultuary fury of the inhabitants. Mr

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* We have given this short abstract of the genealogy of Lord Monboddo, as it forms no improper introduction to the life of a man, who considered the adventitious circumstance of birth as a matter of no small importance, and who has even introduced the subject into his writings. See his *Ant. Metaphysics*, vol. iii. Book ii. chap. 8.

Burnett had taken up his lodgings not far from the prison; and, being aroused from his sleep by the noise of the mob, he hastily dressed himself in his nightgown and slippers, and sallied forth to ascertain the cause of the disturbance. He used frequently to recount the circumstances of that violent proceeding, and dwelt particularly upon the appearance of a stout fellow with a dyer's apron, who demanded that the rope should be given to him, and he would make Porteous dance in the air; which he effectually accomplished, notwithstanding the struggling and resistance of his helpless victim. Though curiosity alone led Mr Burnett to follow in the crowd to the Grassmarket, and to witness this scene of popular outrage, yet it seems that he had been marked, from the singularity of his dress, as having joined in the procession to the place of execution, and would have been laid hold of, had it not been found, upon inquiry, that he had arrived that afternoon from Holland, and consequently could not have had any share in this proceeding.

He passed lawyer in 1738, and, from his relationship with Fletcher of Saltoun, then Lord Justice-Clerk, and with Lord President Forbes, he was soon brought into notice. Lord Tinwald, who was an excellent Greek scholar, shewed him (he used to say) particular attention; and he frequently formed one of the party at the Lord President's Saturday's dinner—an honour, which he often mentioned even in his latter days, as the greatest he had ever received. During the interruption of law business by the rebellion of 1745, he retired to London, where, having been recommended by President Forbes to Dr Murdoch, Dr Armstrong, Mr Thomson, and Mr Mallet, characters of the first celebrity in literature, he spent some months in a manner highly flattering to a young man ambitious of literary reputation. At Thomson's house in Richmond, this circle of friends frequently met, when the bottle went briskly round, and the hours of night fled on the wings of wit and good humour; and, being always accustomed to perform this short journey on foot, they generally drank, like true Scotchmen, at every inn and tavern on the road. Lord Monboddo used to observe, that Thomson's physiognomy, when not roused, was sluggish, dull, and unmeaning, without the slightest appearance of poetical inspiration; but when his heart was warmed with conversation and conviviality, his countenance brightened up, and beamed with expression and intelligence. Of Dr Armstrong as a poet, he always expressed the highest opinion; and, in his third volume on the *Origin of Language*, has bestowed on the *Art of Preserving Health*, a very high, but surely not more than an appropriate eulogium. He represented the Doctor as naturally grave and silent; but said that a bottle of wine made him utter oracles of wisdom. Though they maintained a regular correspondence till a few years before the Doctor's death, yet no traces of it have been found among his Lordship's papers. From the pleasure which he then enjoyed in the company and conversation of these celebrated authors, he was induced frequently to repeat his visits to London; and, in the course of these excursions, he could number among his friends some of the most distinguished characters both for rank and erudition in the kingdom. Among these, we may mention Dr Markham, the late Archbishop of York, the late Earl Stanhope, the first and second Earls of Mansfield, Lords Thurlow and Grantley, Bishops Horsley, Louth, Porteous, Shipley, and Burgess, Sir John Pringle, W. Seward, Esq., George Lewis Scot, Esq., who had been the preceptor of his present majesty, and Mr Harris, the celebrated author of *Hermes*. To Mr Harris he attributed his first knowledge of the Greek commentaries upon Aristotle of the Alexandrian school; and, in the spring of 1769, he made a journey to London, for the express purpose of paying that celebrated author a visit, and of thanking him in person for a present of the new edition of his *Hermes*. During this visit, he was made known to the venerable Lord, afterwards Earl, Bathurst, and the first Lord Lyttleton; with the last of whom he afterwards held a literary correspondence on the subject of language, which is, in part, still preserved among his manuscripts.

About 1760, he married Miss Elizabeth Farquharson, a very amiable woman, whose father, being the nephew of Keith of Cadham, a cadet of the Marischall family, had accompanied Lord Marischall, and his brother Marshall Keith, to the battle of Sheriffmuir,—from whence, however, he escaped, and, concealing himself in the corps of artillery at Woolwich, rose to the rank of captain; in which situation he died at Jamaica in 1741, in the expedition to Carthagena. By this lady he had several children, but these all died infants, except a son and two daughters.

Mr Burnet had now been upwards of twenty years a regular practitioner at the Scotch bar; and though he was an ardent admirer of ancient literature, and had spent much of his time in the pursuit of this favourite study, yet he had never neglected the duties of his profession, and yielded to none either as a lawyer or a pleader. He was a leading counsel, and a keen supporter of the Douglas cause, in favour of Mr Douglas of Douglas; and went thrice to France for the purpose of attending the proof, where he found his readiness of speaking, and even dictating the French language, which he had acquired in Holland, of the utmost service to him upon these occasions, in examining witnesses, and taking down the evidence. This cause had excited much public attention, and had called forth all the abilities and exertions of both parties. Mr Burnet had always the utmost confidence in the justice and ultimate success of his client's claim, and we have no hesitation in declaring, that it was to his firmness, not to mention his knowledge of the law, that Lord Douglas owes the establishment of his birthright, the estates of his uncle, and of consequence his present rank among the peers of Great Britain. It was often mentioned, both by himself and the late William Robertson, Esq. of the Register Office, then Mr Burnett's clerk, that at one time it had been proposed by Mr Douglas's lawyers at Paris, that the cause should be given up as untenable, and that even a letter had been prepared for intimating this opinion to the Duke of Queensbury; but Mr Burnett, in the face of all the other counsel, strenuously opposed this measure, and so far succeeded that the letter was thrown into the fire, and the cause allowed to proceed, which was afterwards brought to a successful issue in favour of Mr Douglas.

Upon Lord Gardenston becoming joint solicitor general with the late Sir James Montgomery, Mr Burnett was appointed sheriff of his native county of Kincardine; and on the death of his relation, Lord Milton, in 1767, he was raised to the bench by the title of Lord Monboddo.[*]

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[*] It is worthy of remark, that his lordship was only the third on the bench in regular succession since the Revolution; his predecessor, Lord Milton, having succeeded Lord Fountainhall in 1725, who was appointed November 1, 1689; and as Lord Monboddo continued a member of the court until his death, this series of three judges occupied more than a century.

This appointment he owed to the friendship of the late Charles Duke of Queensberry, who on this, as well as on another occasion, more than 30 years before in the case of Mr Gay, with which all our readers who have perused the works of Swift and Pope must be acquainted, displayed a respect for genius and literature, and a magnanimity and dignity of character, which throw the brightest lustre on his grace's memory. This nobleman had obtained a promise from the throne, that the first vacant gown in the Court of Session should be bestowed on Mr Burnett. On Lord Milton's death, therefore, the duke waited on his majesty, and reminded him of his promise, which was at once admitted, and orders immediately given to the secretary of state to make out the royal letter. Female intrigue, however, postponed for a time the fulfilment of these orders. The lady of the secretary was nearly allied to the family of Hamilton; and being most naturally solicitous about the vote which Mr. Burnet might give in the great cause which he had taken so much charge of as a counsel, she and the Duchess of Hamilton and Argyle were supposed to have induced their brother-in-law, Mr Secretary Conway, to withhold for many weeks the letter of appointment; and is even supposed to have represented Mr Burnett's character in such unfavourable colours to the Lord Chancellor Henley, afterwards Earl of Northington, that his lordship is reported to have jocosely declared, that if she could prove her allegations against that gentleman, instead of making him a judge, he would *hang* him. This delay gave rise to much idle conjecture and conversation in Edinburgh, and it was confidently reported, that Mr Burnett's appointment would not take place until after the decision of the Douglas cause. Irritated by these insinuations against his integrity, he immediately wrote to the Duke of Queensberry, declaring, that if his uprightness as a judge could be questioned in this cause, he should positively refuse to be trusted with any other; and so highly did he resent the opposition manifested by the secretary to his promotion, that he took measures for canvassing his native county, in order to oppose in parliament a ministry who had so grossly affronted him. The Duke of Queensberry, equally indignant at the delay, requested an audience of his majesty, and tendered a surrender of his commission, as lord justice general of Scotland, if the royal promise was not fulfilled. In a few days the letter was dispatched, and Lord Monboddo took his seat in the court on the 12th of February, 1767. Lord Monboddo's indignation at these proceedings was not of long continuance, but was in a great measure removed with the cause that called it forth. Even the injury which he had received from the noble lady was soon entirely forgotten; and on a visit to Inverary castle, in 1780, he was most cordially received, and entertained with the greatest attention and hospitality.

The life of a Scotch judge presents few incidents for the illustration of the biographer. His attention is daily called to the same routine of business; and the duties of his office, when conscientiously fulfilled, leave him but little leisure, except during the period of vacation, for following other avocations. During these periods, however, Lord Monboddo's whole thoughts were engaged in literary and philosophical pursuits; and so devoted was he to such studies, that he declined the acceptance of a justiciary gown, though pressed upon him both by his noble patron the Duke of Queensberry and by Mr Dundas, afterwards Viscount Melville, lest its duties should interfere with his favourite pursuits. These studies were his chief consolation in the midst of domestic affliction. He had lost, in 1774, a favourite and only surviving son, a very promising boy, in whose education he had taken particular delight; and his lovely wife, the object of his dearest tenderness, and whose exquisite beauty was the least of her attractions, was snatched away from his affections after an union of only six years. She died in autumn 1766, in childbed of a daughter, whose charms were a copy, but a very just one, of those of her mother, and who grew to be the pride and comfort of her father's declining years.

Allured by the charms of ancient learning, and endowed with a genius peculiarly fitted for the perception of its beauties, and the investigation of its doctrines, he gave himself entirely up to the study of its different branches. Criticism, grammar, moral philosophy, and logic, were his prevailing studies; and, in his work *On the Origin and Progress of Language*, he has evinced a critical acuteness, a chasteness of taste in composition, and a discrimination of the various kinds of style, and of the ornaments appropriate to each, which have seldom been equalled; but in the midst of great erudition and genius, candour must acknowledge, that there is, in some of his philosophical works, an absurd mixture of whim and conceit. The first volume of this work was published in 1771, the second in 1773, and the third in 1776. This publication was intended chiefly to vindicate the honour of Grecian literature; and, with the same partiality for antiquity, he began another work in 1778, entitled, *Ancient Metaphysics*, in which he defends the cause of Grecian philosophy. As long as his Lordship has kept close to this subject, he has given very comprehensive views of the doctrines of the ancient philosophers. On these doctrines he was completely at home; but when, in the prosecution of his plan, he advanced into the regions of geometry and natural philosophy, his total ignorance of the modern discoveries, in those sciences, led him not a little into confusion and perplexity. It must be remembered, however, that in the youth of Lord Monboddo, education consisted entirely in classical learning, and in the knowledge of the ancient systems of philosophy, formed by Plato, Aristotle, and their followers. Geometry had not then become a popular study; and natural philosophy and chemistry were little attended to, except by those who followed professions with which they were particularly connected. It was not, therefore, to be expected, that he should renounce the partialities of his youth, and, in the midst of active professional employment, follow, with scientific correctness, the progress of modern improvement in the different branches of philosophy. Let it also be considered, that he was now far advanced in life, and although his judgment was still vigorous and unimpaired, yet his memory had begun to fail him, which may account for the frequent repititions that are to be found in the latter parts of his works. His writings, however, bear internal marks of the extensive erudition and penetrative genius of their author; and to draw their character, would require the pen of a philosopher, learned as himself in all the languages and systems of the ancients, which he has so ably illustrated. His conceits are the eccentricities of genius relying on its own energies, and despising the restraints imposed by established opinions; and, however paradoxical, they discover a discriminating understanding and a benevolent heart. He published, in all, six volumes on language, and the same number on metaphysics; the last volume of which came out a short time before his death

As soon as he became an author, he found his company and conversation courted by many of the most distinguished literary characters of the age. Every stranger of distinction, who visited the capital of Scotland, had letters of introduction to Lord Monboddo, and his house became the resort of genius, literature, and science. To resume the acquaintances of his youth, and to enjoy the conversation of some eminent scholars, whom he could count in the number of his intimate friends, he went to London in the spring vacation of 1780. Here he was so caressed and sought after, and was so delighted with the respect and attention which he universally received, that he continued to pay an annual visit to the metropolis, until he was rendered incapable, by age and infirmities, for undertaking the journey. When in London, his visits were not confined to the library and study of the scholar or man of letters; he took particular delight in shewing himself at court. He frequented the levee and drawing room of St James's; and the king is said to have taken a pleasure in conversing with the old man, with a distinguishing notice that could not but be very flattering to him. But in the midst of this universal respect and esteem, while he was in the very blaze of his reputation as an author, and his declining years were sweetened by the caresses of his family, and the kind attentions of his friends, his feelings received a shock by the death of his youngest daughter, from which he never completely recovered. This young lady, in personal loveliness, was one of the finest women of the age, and was second to none in the graces of her mind. To her father's benevolence of disposition she added his refined taste for elegant literature. Wherever she appeared, she was attended with general admiration, and many were the suitors she attracted to her father's house, and her father's table was often surrounded by all that was truly respectable among the youth of her country. Poetry and the fine arts were her prevailing amusements; and though she mingled in the world of fashion, she shared in none of its follies. Her chief delight was to be the nurse and companion of her declining parent; and her utmost wish to soften, by assiduity and kindness, the pillow of age. "She was the ornament of the elegant society of the city in which she resided," says one of Lord Monboddo's biographers, "her father's pride, and the comfort of his domestic life in his declining years. Every amiable and noble sentiment was familiar to her heart; every female virtue was exemplified in her life." The poet Burns, who, on his first appearance in Edinburgh as an author, was zealously patronized by Lord Monboddo and his daughter, and whose feelings were exquisitely alive to the emotions of gratitude and admiration, celebrates the charms and excellence of Miss Burnett in the following beautiful stanza:—

Thy daughters bright thy walks adorn,
Gay as the gilded summer sky,
Sweet as the dewy milk-white thorn,
Dear as the raptur'd thrill of joy!

Fair B—— strikes the adoring eye;
Heaven's beauties on my fancy shine.
I see the Sire of Love on high,
And own his work, indeed, divine.[*]

By the death of his accomplished daughter, who was cut off by a consumption in the 25th year of her age, the strongest tie was dissolved which bound him to society and to life. From that time he began to droop exceedingly both in his health and spirits, and died at his house in Edinburgh, on the 26th of May, 1799. His disease was a stroke of palsy, which rendered him quite insensible to bodily pain, and he expired without a struggle, at the advanced age of eighty-five.

To a sound discriminating judgment, and a highly cultivated genius, Lord Monboddo added a dignity, benevolence, and integrity of character, which led him to reprobate every action that was inconsistent with the nicest principles of honour, or which savoured of meanness, injustice, and oppression. As a judge, he conscientiously discharged the duties of his office; his decisions were sound, upright, and learned, and always marked with acute discrimination. Although rigidly temperate in all his habits, yet he delighted much in the convivial society of his friends; and he was excelled by none in playful humour, which, being always accompanied in him with the gravity of the judge, was doubly striking in its effects. With the learned he was the philosophic sage; but with the young and the gay, he was the liveliest, the most sportive and playful of the party. His conversation was both amusing and instructive, and excited the wonder and admiration of all his learned acquaintance, for the clear arrangement of his ideas, and the correct and perspicuous language in which they were expressed. His perpetual pursuit was, what he considered the chief object of human life, the improvement and culture of his mental powers. Lord Monboddo, however, had peculiarities in an eminent degree. His unbounded admiration of the customs, the literature, and the philosophy of the ancients, strongly prepossessed him in favour of whatever was connected with such studies. In them he supposed that he beheld all that was praise-worthy and excellent, while he looked upon the moderns as a degenerate race, exhibiting only effeminacy and corruption. This attachment to ancient manners, led him to imitate them even in his amusements and habits of life. He was fond of athletic exercises in his youth, particularly fencing and fox hunting, which tended to strengthen a constitution naturally healthy and robust. His general hour of rising, in all seasons, was six in the morning; and, till a late period of his life, he used the cold bath in the open air, even in the middle of winter. He took a light early dinner, and a plentiful supper. The ancient practice of *anointing* even was not forgotten; though the lotion he used was not the oil of the ancients, but a saponaceous liquid, composed of rose-water, olive oil, saline aromatic spirit, and Venice soap, which, when well mixed, resembled cream. This he applied at bed-time, before a large fire, after coming from the warm bath. His method of travelling was also in conformity to his partiality for ancient customs. A carriage, which was not in common use among the ancients, he considered as an engine of effeminacy and sloth; and to be dragged at the tail of a horse, instead of mounting upon his back, appeared to him to be a truly ludicrous degradation of the genuine dignity of human nature. In all his journies, therefore, between London and Edinburgh, he travelled on horseback, attended by a single servant; and this practice he persisted in, until he was upwards of 80 years of age. On his return, however, from his last visit to London, he was taken so exceedingly ill upon the road, that he was unable to proceed; and had he not been overtaken by a Scotch friend, the late Sir Hector Monroe, who took him into his carriage, and set him down at the first stage, (for he scorned to perform the remainder of the journey in a *box*,) he might, perhaps, have actually perished by the way side.

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[*] Burns, in a letter to Mr Chalmers, dated from Edinburgh, 27th December, 1786, bears farther testimony to the charms and excellence of this lady: "One blank," says he, "in the Address to Edinburgh, 'Fair B——,' is the heavenly Miss Burnett, daughter to Lord Monboddo, at whose house I have had the honour to be more than once. There has not been any thing nearly like her, in all the combinations of beauty, grace, and goodness, the great Creator has formed, since Milton's Eve on the first day of her existence." See Currie's *Life of Burns*, vol. ii. p. 35.

As Lord Monboddo accounted population the true wealth of an estate, he spent much of his leisure time, during the vacations of the court, in improving his paternal inheritance, by cultivating an extensive farm round the family mansion; and his principal desire was to increase the number of souls upon his lands, so as to make it greater in proportion to the extent, than that of any neighbouring landholder. While in the country, he dressed like a plain farmer, and lived among his tenants with all the patriarchal familiarity and attention of an aged father among his grown up children. He encouraged them all by his advice and example, and, what was more substantial, by long leases, *almost rights of inheritance*, as he not very improperly called them. For these patriotic exertions, his memory will be recorded and revered in Kincardineshire as long as agriculture and hospitality shall continue to be practised. (*p*)

BURNING. See Chemistry.

BURNING of the Dead. All the nations of the world, rude and civilized, have, in every age, exhibited some remarkable ceremonial in the disposal of their dead. Some, by simple inhumation, have restored the body to its parent earth; others have committed it to the waters; and others again have reduced it to ashes, which were either collected as precious memorials of the deceased, or dissipated in the air. In one respect, perhaps, this latter custom has been adopted, to testify the unwillingness of the survivors to part with all remembrance of a departed person; and there are nations which yet preserve the corpse entire in token of veneration, or, despoiling it of the flesh, carefully keep the bones. However, the necessity of destroying the body, or some religious rite, has probably operated as a more general inducement. Cremation, or burning the dead, has been practised in Europe, Asia, and the vast continent of America, from the most remote period to which authenticated history can reach: and although it has partially given way to other customs, there are many places where it is retained to the present day.

Remounting to Jewish history, long before the birth of Christ, we are told, that after Saul fell on his own sword, "all the valiant men arose, and went all night, and took his body and that of his sons from the wall of Beth-shan, and came to Jabesh, and burnt them there." The same is to be inferred from various other passages; but it is doubtful whether Aza king of Judah was burnt, as generally believed, because it is only said in scripture that there was a burning for him—not of his body; and Jeremiah addresses Zedekiah thus: "Thou shalt not die by the sword; but thou shalt die in peace, and with the burning of thy fathers, the former kings who were before thee; so shall they burn odours for thee." Thus the burning of odours may have been some rite or ceremony in honour of the deceased among the Jews.

But we are better acquainted with the Greek and Roman modes of cremation, from the histories transmitted to our own time. A lofty pile was constructed, on which the body was laid, various ceremonies ensued, and the whole was then reduced to ashes. Yet although the custom of burning the dead generally prevailed, it was not in universal practice: there were some absolute exceptions; and in other cases it depended on the circumstances of the deceased, or those of his relations. Among the Romans, infants who had not got their first teeth were never burnt, somewhat like the custom of Christians in denying consecrated ground to those that perish in the earliest infancy. Those struck with lightning also were interred, probably from thinking it impious to commit to earthly flames bodies which had been touched by the fire of heaven.

The ancients were more prone to a minute and systematic performance of each of the different funereal rites, from the peculiar superstitions which they entertained. They believed, that unless the body was returned to the earth by inhumation, or entombed after being reduced to ashes, access was denied to the Elysian fields. Thus their principal care was pious offices to the dead.

As the Romans believed that the soul forsook the body by the mouth, the nearest relative watched the moment of its flight to receive it by an inspiration. The eyes and mouth of the corpse were then closed by the same individual, or if a husband by the wife, and of a wife by the husband. Next the body was washed and anointed by women, with precious unguents; and after a certain interval the name of the deceased loudly called, either from some superstitious motive, or to avoid the hazard of a premature death on the funeral pile, if the person was only in a swoon. Examples are recorded of those who were on the bier reviving, descending from it, and walking home in health; and a noted instance also occurred, where one, aroused from insensibility by the flames of the pile crackling around him, made an ineffectual endeavour to escape, and was burnt alive. The rings, which constituted a distinguished mark of rank among the Romans, were now taken from the fingers of the deceased, though restored before the whole ceremony of cremation was concluded.

In the next place, the corpse being clothed in the best garment worn during life, was laid on a couch, sometimes constructed of costly materials, such as that of Cæsar, which, Suetonius relates, was of ivory, adorned with purple and gold. This was borne to the pile by the nearest relatives; or, if the deceased had enjoyed celebrity, his body was supported on the shoulders of others of note. Thus Augustus, whose obsequies were performed with great solemnity, was carried to the pile in the Campus Martius by senators, and Julius Cæsar, in like manner, by the magistrates of Rome. Others were supported by their freedmen; and Trebius, who had relieved the wants of the people in time of scarcity, was borne on their shoulders to be burned. Although cremation was denied to infants, yet if they attained a certain period, the ceremonial demanded that they should be borne to the funeral pile by their mothers.

Much funeral pomp was now displayed: In bearing the corpse to the pile, each attendant had his own place assigned; and along with the couch were carried many others, containing waxen busts of the ancestry and relatives of the deceased. A solemn dirge was sung, accompanied by trumpets and other instruments, and an oration in honour of the deceased was recited. While that on Julius Cæsar was heard, his body rested under a gilt pavilion, and the robe in which he had been killed was suspended aloft to public view. His image, also, exhibiting all the wounds he had received, was exposed in a moveable carriage.

The pile prepared to receive the deceased was of a pyramidal form, lofty in proportion to the rank he had enjoyed. When the couch bearing the corpse was deposited upon it, the eyes were opened, and the rings restored to the fingers. Then the nearest relation filled the mouth with a certain aromatic potion, and, turning away his face, applied a lighted torch. Perfumes were thrown over the pile; wine poured among the flames to promote the conflagration; and invocations offered up for the aid of the winds to consume the body.

In the mean time, if the pile was that of an illustrious warrior, the soldiers marched three times around it with inverted weapons, and striking the ground at certain intervals.

Various bloody sacrifices were made to the manes of the deceased: Animals were thrown into the fire; dogs and horses were destroyed along with their owners; nay, slaves and captives were also barbarously burnt alive. Every thing that the deceased prized during life was consumed; so that it might, according to the superstitions of the ancients, be useful to him after death. But to avoid the cruelty and expence of burning slaves or captives, a blood-coloured vestment was generally thrown on the pile.

Games, pantomimes, and the combats of gladiators followed, at which one of the most conspicuous characters was the *Archimimus*, who personated the manners of the deceased. At the funeral of Vespasian, the archimimus, with the characteristic avarice of that emperor, declared, that, rather than that the intended expence should be lavished on his obsequies, he would have his body thrown into the Tiber. The games were protracted during three days at the funeral of Publius Licinius; and Livy records, that no less than seventy gladiators fought on the occasion.

When the pile was consumed, the fire was extinguished, and the embers soaked in wine. The nearest relatives, or eminent men, habited in loose robes, and bare-footed, collected the bones and ashes together. Thus, the chief of the equestrian order, attired in robes, and wanting sandals, gathered the remains of the Emperor Augustus. The ashes, after being sprinkled with wine and the richest perfumes, were committed to an urn, and the whole was consigned to the earth or to a tomb.

After returning from the ceremony, those who were occupied in it stepped over a fire for purification, as all who had seen a corpse were defiled; and priests and magistrates, before resuming their functions, were obliged to offer an expiatory sacrifice.

These general observations, as far as can be ascertained, apply to the Carthaginians, Greeks, and Romans, as well as to other nations of antiquity. With respect to the Romans, it is not well known how the ceremony commenced, or what were the causes of its discontinuance. Macrobius, who lived in the lower era of the empire, when describing the custom also spoken of by Plutarch, of adding the body of a woman to those of ten men, if numbers were burnt at a time, distinctly states, that in his own time burning the dead was not practised.

The true or fabulous histories of many nations cotemporary with the Romans, and rising into notice at the period of their overthrow, refer to the burning of the dead; and their own accounts receive corroboration from the observations of others. Cæsar relates, that the funerals of the Gauls were magnificent, and that every thing esteemed by the deceased was consumed along with his body; and Tacitus assures us, that although the Germans exhibited less ostentation, the bodies of illustrious persons were burnt with certain kinds of wood; and that the arms of all, and the horses of some, were consumed along with them. The practice extended over the north; and, descending still later, we find the Danes erecting piles to their warriors, the flames whereof might "reach to heaven."

Burning of the dead, as we shall presently see, is not uncommon among the natives of the British territories in India. But this ceremony is attended with some singular circumstances among the *Cucis* or Kookies, a savage race of mountaineers dwelling to the north-east of Chittagong. When any one dies in a village, the body is carried by his relatives to some distance from the house, and deposited on a stage under a shed erected for the purpose. Some member of the family daily places a supply of meat and drink before the corpse, and assiduously guards it from the depredations of dogs and birds while it remains in the shed. If another of the same family dies, the corpse is brought to the same place, and similar ceremonies are observed. Whatever be the time of decease, all the bodies are thus kept until the 11th of April, on which day the relatives assemble, and convey them to funeral piles, prepared on a certain spot within the precincts of the village, where they are burnt. The sheds where they had been deposited are likewise consumed. This ceremony being over, the whole persons concerned in it repair to the house of him in whose family the first death occurred in that year, and partake of an entertainment given in honour of the dead. On the following day, a similar entertainment is given by him in whose family the next casualty happened; and so on with the rest, until a feast has been given for each of the departed.

This feast in honour of the dead, called *silicernium* by the Romans, is given almost over the whole world, and is a rite still retained in Britain. Certain tribes of American savages preserve the remains of the deceased in the same way as the Kookies, until a certain time of the year.

The bodies of deceased Birmans are burnt; but as the ceremony is attended with great expence, this honour is not conferred on the poor. Funerals are solemnized with much religious parade and semblance of grief in the kingdom of Ava. The corpse, preceded by women chaunting a dirge, is carried in slow procession on a bier on men's shoulders, and attended by the relatives in mourning. When placed on a pile, which is about six or eight feet high, formed of billets of dried wood laid across, with interstices to admit the air and promote the conflagration, the priests walk around, reciting prayers to their deity. When the fire reaches the body, it is quickly reduced to ashes; and the bones, being afterwards collected, are deposited in a grave. The bodies of the chief ecclesiastic of a province, and of persons of exalted station, are embalmed, and lie in state in some religious edifice six weeks before they are committed to the pile.

Cremation of the dead is practised by the natives of New Holland, a race which ranks lowest in the scale of mankind. The surviving husband constructs a pile to consume the body of his departed wife: he collects her ashes, and, depositing them in the earth, erects a rude and simple memorial of her on the spot. See *Herodotus*, p.

490; Pomponius Mela *de Situ Orbis*; *Diodorus Siculus*, lib. xix.; Suetonius *in Vit. Jul. Cæsaris*, *August. Vespasian*, § 84, 101. 95.; Cæsar *de Bell. Gall.* lib. 6. cap. 18; Ælian *Variæ Historiæ*, lib. v. cap. 6. *Dio.* 54, 59; Gutherius *de Jure Manium*; Keysler *Antiquitates Selectæ Septentrionalis*; Bartholinus *Libri Antiquitatum Danicarum*, p. 507.; Brown *on Urn Burial*; Holwell's *Historical Events*; Campbell's *Journey over Land*; Hodge's *Travels in India*; *Asiatic Researches*, vol. v. vii.; and *Asiatic Annual Register*, vol. xi. For an account of the ceremony of Burning the Living, see the above works, and the article CREMATION. (*c*)

BURNING INSTRUMENTS.

BURNING instruments, are optical instruments for producing an intense heat from the concentration of the solar rays, either by reflection or refraction. When the concentration is effected by reflection alone, the instruments may be called CATOPTRIC BURNING INSTRUMENTS; when the effect is produced by refraction, they may be called DIOPTRIC BURNING INSTRUMENTS; and when the rays are concentrated both by mirrors and lenses, they may be called CATADIOPTRIC BURNING INSTRUMENTS. In proceeding, therefore, to give an account of the different instruments which have been employed for this purpose, we shall arrange them under these three heads.

On CATOPTRIC BURNING INSTRUMENTS.

It appears, from the authority of Plutarch, that the ancients were acquainted with the power of concave mirrors to concentrate the solar rays, and to burn substances placed in their focus; and there is every reason to believe, that it was by a contrivance of this kind that the vestal fires were rekindled. This method, however, of producing an intense heat from the solar rays, can be practised only at short distances, and is completely incapable of producing those tremendous effects at a distance which Archimedes is said to have exhibited at the siege of Syracuse.

The concurring testimonies of several ancient authors* sufficiently establish the general fact, that by a combination of mirrors, constructed by Archimedes, the Roman fleet was either partly or wholly consumed. By means of a similar apparatus, as we are informed by Zonaras, (*Annal.* lib. xiv. p. 55.) Proclus destroyed the Gothic ships in the harbour of Constantinople, in order to protect his benefactor, Anastasius, against the bold attempt of Vitalian.

The credibility of these statements has been seriously questioned by many modern mathematicians of the highest eminence, and the exploits of Archimedes at Syracuse have been confidently ranked among the fables of antiquity. All this scepticism, however, seems to have been founded on the supposition, that the Syracusan philosopher employed concave mirrors; for if we suppose, along with Kircher and Buffon, that Archimedes employed a combination of plain mirrors, and if we make some allowance for the exaggeration of ancient authors, we must admit it as a fact well authenticated, and in no respect contradicted by the principles of optics, that Archimides constructed a burning machine, by which he set fire to the Roman fleet at a considerable distance. When the rays of the sun are reflected from a plain mirror upon any object, the space occupied by the reflected light is always greater than the surface of the mirror, and this space increases with the distance of the object. The heat which is lost by reflection does not much exceed one-half of the direct heat of the solar rays; so that two plain mirrors, which reflect the sun's light upon an object moderately distant, will produce a degree of heat nearly equal to the direct heat of the sun. By increasing, therefore, the number of mirrors, the reflected heat of the sun may be increased to any assignable magnitude. If the distance of the object is increased, the space occupied by the reflected rays from each mirror will also be increased; and, in proportion to this augmentation, the intensity of the heat will be diminished; but this diminution of the heat may be compensated by increasing the number of the mirrors. Hence it is possible, theoretically speaking, to produce any degree of heat at any given distance. In practice, however, the distance at which combustion may be effected is limited by several causes. While the reflected rays pass through the atmosphere, their force is considerably diminished by the density of the medium; and even when the plain mirrors are formed with the utmost care, they are still by no means free from irregularities on their surface. The angular deviation produced by these irregularities increases with the distance at which the reflected rays are received; and at the distance of a mile, the reflected light, instead of forming one large image, would be separated into various detached portions.

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* The authors who mention the mirror of Archimedes, are Lucian, Galienns, Anthemius, Eustatius, Tzetzes, and Zonaras.

Lucian, in his Hippias, simply states, that Archimedes, by a singular artifice, reduced the ships of the Romans to ashes. Galienus observes, (*De Temperamentis*, lib. iii. cap. 2. tom. 1. p. 81. Edit. Basil.): "It is in this way, at least I think so, that Archimedes burnt the enemy's vessels. For, by the help of a burning mirror, he may easily set fire to wool, hemp, wood, &c.; and, in short, to any thing dry and light."

Eustathius remarks, in his commentary on the Iliad, E. p. 338. that Archimedes, by an invention in catoptrics, burned the fleet of the Romans at a distance equal to the shot of an arrow from a bow. According to Zooaras, (*Annal.* lib. ix. p. 424.) "Archimedes burnt the fleet of the Romans in an admirable manner; for he turned a certain mirror towards the sun, which received its rays. The air having been heated on account of the density and smoothness of this mirror, he kindled an immense flame, which he precipitated on the vessels which were in the harbour, and reduced them to ashes."

"When the fleet of Marcellus (says Tzetzes, *Chiliad* ii. 119.) was within bow-shot, the old man (Archimedes) brought out a hexagonal mirror which he had made. He placed, at proper distances from this mirror, other smaller mirrors, which were of the same kind, and which were moved by means of their hinges, and certain square plates of metal. He afterwards placed his mirror in the midst of the solar rays, precisely at noon day. The rays of the sun being reflected by this mirror, he kindled a dreadful fire in the ships, which were reduced to ashes at a distance equal to that of a bow shot. Dion and Diodorus, who wrote the life of Archimedes, and several other authors, speak of this fact; but chiefly Anthemius, who wrote on the prodigies of mechanics: it is in these works that we read the history of the conflagration occasioned by the mirror of Archimedes."

Though these authorities are conclusive, yet no notice is taken of Archimedes's mirror by Polybius, Livy, and Plutarch.

The next burning mirror that seems to have been constructed after that of Archimedes, was contrived by Anthemius of Tralles, who flourished towards the end of the fifth century. This learned architect was a favourite of Justinian, who employed him in the construction of various edifices, but particularly in the church of St Sophia at Constantinople, which he designed and executed. He was also the disciple of Proclus, from whom he probably received some information respecting the construction of burning mirrors, of which he has given a full and distinct account in a fragment, entitled Περι παραδοξων μηχαμηματων. "Of Wonderful Machines," which has been translated and illustrated by M. Dupuys, in the *Memoires de l'Academie des Inscriptions*, 1777, tom. xlii. p. 392—451. The following quotation from this fragment, will give the reader a complete view of the invention of Anthemius, who appears to have been completely master of the subject upon which he wrote. After acknowledging, that it was universally admitted in his time, that Archimedes had destroyed the Roman fleet by means of burning mirrors, Anthemius observes, "Let us, therefore, bring and collect at one point other different rays, by means of plain and similar mirrors, in such a manner that all these rays, united after reflection, may produce inflammation: This may be effected by means of several persons holding mirrors, which, according to the positions indicated, send the rays to one point.

"But, in order to avoid the embarrassment resulting from entrusting this operation to several persons, (for we shall find, that the matter intended to be burnt does not require less than twenty-four reflections,) the following construction must be followed: Let there be a hexagonal plain mirror, and other adjoining similar mirrors attached to the sides of the hexagonal mirror by the smallest diameter, so that they may be moved on these lines by means of plates or bands applied, which unite them to each other, or by means of what are called hinges. If, therefore, we bring the surrounding mirrors into the same plane with the mirror in the centre, it is clear, that all the rays will undergo a reflection similar, and conformable to the common position of all the parts of the instrument. But if, the centre mirror remaining as it were immoveable, we dexterously incline upon it all the other mirrors which surround it, it is evident that the rays reflected by them will tend towards the middle of the place where the first mirror is directed. Repeat the same operation, and around the mirrors already described placing other similar mirrors, all of which may be inclined towards the central mirror, collect towards the same point the rays which they send, so that all these united rays may excite inflammation in the given spot.

"But this inflammation will take place better, if you can employ for this purpose four or five of these burning mirrors, and even seven, and if they are all at the same distance from the substance to be burnt, so as that the rays which issue from them, mutually intersecting, may render the inflammation more considerable: For, if the mirrors are all in one place, the rays reflected will intersect at very acute angles; so that all the place around the axis being heated, the inflammation will not take place at the single point given.

"It is therefore possible, by means of the burning mirrors just mentioned, to carry inflammation to a given distance. Those who have made mention of the mirrors constructed by the divine Archimedes, have not said that he made use of a single burning mirror, but of several; and I am of opinion, that there is no other way of carrying inflammation to any distance."

From the demonstration which Anthemius proceeds to give, but which we have not room for inserting, it appears that his mirror was constructed on exact geometrical principles, and was truly parabolic.

About the end of the sixteenth century, when an ardour for science began to prevail, we find the subject of burning mirrors again brought into notice. Our countryman, Leonhard Digges, in a work entitled *Pantometria*, published in London in 1571, and republished by his son Thomas Digges in 1591, mentions a burning mirror, which appears to have consisted of a combination of plain mirrors. In the Preface to the second edition, Mr Thomas Digges observes, "Archimedes also (as some suppose,) with a glasse framed by reuolution of a section parabolicall, fired the Roman nauie in the sea, comming to the siege of Syracusa. But to leave these celestial causes, and things donne of antiquitie, long agoe, my father, hath at sundrie times, by the sunne beames, fired powder and dischargde ordinance *half a mile* and more distante; which things I am the boulder to report, for that there are yet liuing diuerse of these his doings (*oculati testes*, eye witnesses,) and many other matters farre more strange and rare, which I omit as impertinent to this place."

In the 21st chapter of the first book, the subject of burning glasses is resumed. "Some have fondly surmised, that Archimedes burned the Roman nauie with a portion of a section parabolical artificiallye made to reflect and unite the sunne beames a great distance off, and for the construction of this glass toke great peines, with high curiositie, to write large and many intricate demonstrations, but it is a mere fantasie and utterly impossible, with any one glass whatsoeuer it be, to fire any thing only one thousand pace off, no though it were an 100 foote ouer, marry true it is the parabola for his small distance, most perfectly doth unite beames, and most uehemently burneth of all other reflecting glasses. But how by application of mo glasses to extend this unitie or concourse of beames in his full force, yea to augment and multiply the same, that the farder it is carried the more violently it shall pearse and burne. *Hoc opus, hic labor est*, wherein God sparing life and the time which opportunitie seruing, and minde to impart to my countrymen some such secrets, as hath I suppose in this our age been reuealed to very few, no lesse seruing for the securitie and defence of our naturall countrey, than surely to be maruailed at of strangers."

A few years after the publication of the *Pantometria* of Leonhard Digges, our illustrious countryman Baron Napier of Merchiston, drew up a list of "secret inventions, profitable and necessary in these days for the defence of this island, and withstanding of strangers, enemies of God's truth and religion." The first and second of these inventions are burning mirrors, which Lord Napier has very briefly described in the following words:

First, "The invention, proof, and perfect demonstration, geometrical and algebraical, of a burning mirror, which receiving of dispersed beams of the sun, doth reflect the same beams altogether united, and concurring precisely in one mathematical point, in the which point most necessarily it engendereth fire; what an evident demonstration of their error who affirm this to be made a parabolic section. The use of this invention serveth for the burning of the enemy's ships at whatsoever appointed distance."

Secondly, "The invention and sure demonstration of another mirror, which receiving the dispersed beams of any material fire, or flame, yieldeth also the former effect, and serveth for the like use."

It does not appear that Napier ever condescended to give any farther account of these burning mirrors; for when he was solicited, a short time before his death, by one of his most particular friends, "not to bury such excellent inventions in the grave with him," he replied, "that for the ruin and overthrow of man there were too many devices already framed, which, if he could make to be fewer, he would with all his might endeavour to do; and that therefore seeing the malice and rancour rooted in the heart of mankind, will not suffer them to diminish the number of them, by any new conceit of his, they should never be increased."

The next burning mirror of which we have any account, was invented by the learned Athanasius Kircher. This indefatigable philosopher made a great variety of experiments, for the purpose of establishing the authenticity of Archimedes's burning mirrors. He began with combining a number of parabolic specula; but this method was quickly abandoned, and he resorted to the use of plain mirrors. Having procured a number of plain and circular glasses, he placed them upon a wall, at such degrees of inclination that they all reflected the light of the sun to one point, and produced a considerable heat. His principal experiments, however, were made with five plane specula fixed in a frame, so that they collected the solar rays at the distance of more than one hundred feet. At this distance he produced a degree of heat which sufficiently convinced him, that by increasing the number of his mirrors, he could have consumed inflammable substances at a much greater distance. He informs us in his *Magica Catoptrica*, that the heat of the first reflection was different from that of direct light; that the light when doubled gave a very perceptible increase of heat; that it had the heat of a fire when tripled; that when quadrupled, the heat could still be endured; but that a fivefold reflection made the heat almost intolerable. From these results he concludes, that a combination of plain mirrors was capable of producing more powerful effects, than mirrors of a parabolic, hyperbolic, or elliptic form; and he entreats future mathematicians to prosecute the subject with a more numerous combination of plane specula. Not satisfied with these trials, Kircher, accompanied by his pupil Schottus, made a voyage to Syracuse in order to examine the position of the hostile fleet, and they were both completely convinced, that the ships of Marcellus could not have been more than thirty paces distant from Archimedes.

The seventeenth century was distinguished by the production of various burning mirrors, of different constructions. The principal of these were made by M. Vilette, a French artist at Lyons, who appears to have constructed no fewer than five of considerable magnitude. One of them was bought by M. D'Alibert for 1500 livres: another was purchased by Tavernier, and presented to the King of Persia: a third was sent by the French king to the Royal Academy: a fourth was bought by the King of Denmark; and the fifth was brought to England for public exhibition. The first of these mirrors was thirty inches in diameter, and weighed above a hundred weight. Its focal length was about three feet, and the size of the sun's image was about half a Louis d'or. It was mounted on a circular frame of steel, and could easily be put into any required position. This mirror was made in 1670, and having been brought to St Germains by the order of the king, his majesty was so well pleased with it, that he rewarded Vilette with a hundred pistoles for the sight of it, and afterwards purchased it, and placed it in the royal observatory at Paris. The effects were the following:

	Seconds.
A small piece of pot iron was melted in . .	40
A silver piece of fifteen pence was pierced in .	24
A thick nail (*le clou de paysan*) melted in .	30
The end of a sword blade of Olinde burnt in .	43
A brass counter was pierced in . . .	6
A piece of red copper was melted in . .	42
A piece of chamber quarrystone was vitrified in	45
Watch-spring steel melted in	9
A mineral stone, such as is used in harquebusses *a'rouet*, was calcined and vitrified in . .	1
A piece of mortar was vitrified in . . .	52
Green wood and other bodies took fire instantly.	

The mirror of M. Vilette which was brought to England was put into the hands of Dr Harris and Dr Desaguliers, who made several trials with it. It was a composition of copper, tin, and tin glass; and its reflection had something of a yellow cast. There were only a few small flaws in the concave surface, but there were some holes in the convex side which was polished. The diameter of the mirror was 47 inches, its radius of curvature 76 inches, and its focal length 38 inches. The following results were obtained in July 1718, between 9 and 12 o'clock in the morning, and the time was measured by a half-second pendulum.

	Seconds.
A red piece of Roman patera began to melt in	3
and was ready to drop in . . .	100
A black piece of the same melted in . . .	4
and was ready to drop in . . .	64
Chalk taken out of an echinus spatagus filled with chalk, only fled away in . . .	23
A fossil shell calcined in	7
and did no more in	64
The black part of a piece of Pompey's pillar melted in	50
And the white part in	54
Copper ore, with no metal visible, vitrified in .	8
Slag or cinder of the iron work said to have been wrought by the Saxons, was ready to run in .	29½

The mirror now became hot, and burned with much less force.

	Seconds.
Iron ore fled at first, but melted in . . .	24
Talc began to calcine at	40
and held in the focus	64
Calculus humanus was calcined in . . .	2
and only dropped off in . . .	60
The tooth of an anonymous fish melted in . .	32½
The asbestos seemed condensed a little in . .	28

But it now became cloudy. M. Vilette says that the mirror usually calcines asbestos.

A golden marchesite broke, and began to melt in	30
A silver sixpence melted in	7½

	Seconds.
A King William's copper halfpenny melted in	20
and ran with a hole in it in	31
A King George's halfpenny melted in	16
and ran in	34
Tin melted in	3
Cast iron melted in	16
Slate melted in	3
and had a hole in	6
Thin tile melted in	4
and had a hole and was vitrified through in	80
Bone calcined in	4
and vitrified in	33

An emerald was melted into a substance like Turquoise stone, and a diamond that weighed 4 grains lost $\frac{7}{8}$ths of its weight.

This mirror was made by M. Vilette, some years after the first, and with the assistance of his two sons. It came into the possession of M. Vilette the son, engineer and optician to his electoral highness of Cologne, bishop and prince of Liege, where he commonly resides. At the desire of several learned men, M. Vilette brought it to London, where its effects were exhibited in Priory garden, Whitchall.

The burning mirrors of Maginus, and of Manfredi Septala, a canon of Milan, do not appear to have produced such powerful effects as those of M. Vilette. The mirror of Maginus was only 20 inches in diameter, and it would appear from the different accounts in the *Philosophical Transactions*, that Septala had constructed two mirrors. The first, which was five palms, or about 3½ feet in diameter, had a long focal length; but there is no particular information respecting its effects, which seem to have been far from powerful, as a gentleman who had seen it, declared, "*that it could not set wood on fire but after the time of saying a* MISERERE!" a method of measuring time not much in use among experimental philosophers. The other burning mirror of Septala seems to have been about seven feet in diameter, and to have had a focal length of 50 palms, or about 33 feet. See Schottus *Magia Univers.* Part I. vol. vii. § 6. p. 418.

In the year 1685, M. De la Garouste presented to the Academy of Sciences, a large metallic mirror, five feet two inches in diameter, and five feet in focal length. It was not equally polished, and a piece was inserted in the middle of it where the metal had failed. This circumstance, however, did not seem to diminish its force. Several trials were made with this mirror in the Academy, by order of M. De Louvois, but the precise effects which it produced have not been detailed. It is merely stated, that those who tried it were satisfied with the results, and that its effects would have been much greater had it been better polished, and mounted upon a proper stand.

On the 27th of February, 1667—8, Francis Smethwick, Esq. produced before the Royal Society two burning concave glasses, ground of a *newly invented figure*, which was probably that of a parabola. One of them was six inches diameter, with three inches of focal length; and the other was of the same diameter, with its focus ten inches distant. When these were brought towards a large lighted candle, they somewhat warmed the faces of those that were four or five feet distant; and when held to the fire, they burnt gloves and garments at the distance of about three feet from the fire. At another experiment made in the presence of Dr Seth Ward, the deeper of the two burned a piece of wood into flame in the space of ten seconds, and the shallower one in five seconds. This experiment was made in autumn, at nine o'clock in the morning, when the weather was gloomy. By exposing the deeper concave to a northern window on which the sun did not shine, it was found to warm the hand by "collecting the warmed air in the day time, which it would not do after sunset."

The burning mirror constructed by the celebrated M. Tschirnhausen, was formed of copper plate, scarcely twice as thick as the back of an ordinary knife. It was about three Leipsic ells in diameter. It was well polished; and burnt at the distance of two Leipsic ells.* The following results were obtained with it:

1. A piece of wood held in the focus, flames in a moment, so that a fresh wind can hardly put it out.
2. Water applied in an earthen vessel immediately boils; and the vessel being kept there some time, the water evaporates all away.
3. A piece of tin or lead three inches thick melts away in drops as soon as it is put in the focus; and when held there a little time is in a *perfect fluor*, so that in 2 or 3 minutes it is quite pierced through.
4. A plate of iron or steel becomes immediately red hot, and soon after a hole is burnt through it.
5. Copper, silver, &c. melt in five or six minutes.
6. Stones, brick, &c. soon become red hot.
7. Slate becomes red hot, but in a few minutes turns into a fine sort of black glass.
8. Tiles which had been exposed to the most intense heat of fire, melt down into a yellow glass.
9. Pot-shreds, that had been much used in the fire, melt into a blackish yellow glass.
10. Pumice stone melts into a white transparent glass.
11. A piece of a very strong crucible melted into a glass in 8 minutes.
12. Bones were converted into a kind of opaque glass, and a clod of earth into a yellow or greenish glass.
13. The beams of the full moon when at her greatest altitude were concentrated by this speculum, but no perceptible degree of heat was experienced.

Zacharias Traberus mentions in his book, *In Nervo Optico*, that burning mirrors may be constructed by turning a large concave of wood, laying its surface equally with pitch, and covering it with square pieces of leaf gold about two or three inches broad. Large mirrors, he says, may be made of 30, or 100, or more concave pieces, artfully joined in a turned wooden dish or scuttle.

Zahnius, in his work *In Oculo Artific.* fundam. 3. informs us, that one Neuman, an engineer at Vienna, formed burning mirrors of pasteboard, covered on the inside with straw glued to it, and that their effect was so powerful as to melt metals almost instantly.

Parabolic mirrors of a large size, and very considerable power, were constructed by M. Hoesen of Dresden, and afterwards by M. Ehrard. These mirrors were composed of several pieces of solid wood, and on the convex part were pieces of wood, both diverging from the vertex and transversely, nicely fitted and strengthened. The concave part of this framing was covered with copper-plate $\frac{1}{8}$ of an inch in thickness, 4½ feet long, and 2½ feet broad, so as to resemble one piece, finely polished. The speculum was so supported as to be easily managed, and the anterior part of it was subtended by an iron arch half an inch thick. The middle of this arch, which coincided with the place of the burning focus, was perforated into a ring, which supported from both sides an iron fork for receiving the body to be examined. Four of Mr Ehrard's mirrors constructed in this way had the following dimensions :

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* In another account its diameter is said to be 4½ feet, and its focal length 12 feet.

	Perimeter.		Diameter, or ordinate.		Depth or absciss.		Focal length.	
	Feet,	Inches	Feet,	Inches.	Feet,	Inches.	Feet,	Inches.
No. 1	29	4	9	7	1	4	4	0
2	21	0	6	8	0	10½	3	1
3	16	4	5	1	0	10½	1	10
4	13	2½	4	2	0	7	1	9

The celebrated Wolfius, who had witnessed the effects of these mirrors, assures us, that in burning, calcining, melting, and vitrifying, they far exceeded any thing of the kind ever known. The hardest stones scarcely resisted a few seconds. Metals were rapidly perforated, and vegetables and bones were immediately burnt to a cinder and vitrified.

Our celebrated countryman, Dr James Gregory, turned his attention to the construction of burning machines, about the year 1670 ; and in a letter to Mr Collins, dated St Andrews, 7th March, 1673, he states his views on this subject, and requests Mr Collins to communicate them to Sir Isaac Newton, who returns a favourable opinion of the invention, in a letter to Mr Collins. The passages in these letters are too interesting to be given in any other form than in the original words of these distinguished authors.

" Mr Newton's discourse of reflection," says Dr Gregory, " puts me in mind of a notion I had of burning glasses several years ago ; which appears to me more usefull than subtile. If ther be a concave speculum of glasse, the leaded convex surface having the same center with the concave, or to speak preciselie, albeit perchance to little more purpose, let the radius of the convexitie be c, the thicknes of the glasse *in axis transitu* f, the radius of the convexitie equal to $\frac{9c^2 + 18cf + 5f^2}{9c + 5f}$ this speculum sal have the *foci* of both the surfaces in the same point ; and not onlie that, but all the rays which are reflected betwixt the two surfaces, sal, in their egresse, come, *quam proximé*, to the common focus. The making of such an speculum, requireth not much more airt than an ordinar plane glasse, seing great subtiltie is not necessar here : so that I believe they who mak the plane miroir glasses, wold mak one of these, three foot in diameter, for four or five pounds sterling, or little more : for I have seen plane glasses, almost of that bignes, sold even here for less money. Now seing (as Mr Newton observeth) that al reflecting metalls lose more than one-third of the rayes ; this concave glasse, even *cæteris paribus*, wold have an great advantage of a metall one ; for certainlie an exactlie polished thin miroir-glasse, of good transparent mater, after a few reflections, doeth not lose one-fourth of the rayes : and, upon other accounts, this hath incomparable advantages, seing it is more portable, free from tarnishing, and, above al, hardlie $\frac{1}{20}$th of the value. The great usefulness of burning concaves, this being so obvious, and as yet (for quhat I know) untouched by anie, makes me jealous that there may be in the practice some fallacie. Ye may communicate this to intelligent persons, and especiallie to Mr Newton ; assuring him that none hath a greater veneration for him, admiring more his great and subtile inventions, than his and yours.

P. S. If ye please, let me hear, with the first convenience, what may be judged the result of this burning concave ; for I am as much concerned to be undeceived, if ther be any insuperable difficultie, as to be informed of an most surprising success. I have spoke of it to severals here, but al wer as ignorant of it as my self," &c.

Sir Isaac Newton's reply to Mr Collins is dated Cambridge, April 9th 1673, and contains the following passage :—

" The design of the burning speculum appears to me very plausible, and worthy of being put in practice. What artists may think of it, I know not ; but the greatest difficulty in the practice, that occurs to me, is to proportion the two surfaces so, that the force of both may be in the same point according to the theory. But, perhaps, it is not necessary to be so curious ; for, it seems to me, that the effect would scarce be sensibly less, if both sides should be ground to the concave and gage of the same tool, &c. &c."

The attention of Sir Isaac Newton being thus accidentally directed to the subject of burning instruments, he procured seven concave glass mirrors, each of which was eleven and a half inches in diameter, and six of these were placed round the seventh, and contiguous, but so as to have one common focus. The general focal length was 22 inches and a half, and about an inch in diameter. It melted gold in about half a minute, and vitrified brick or tile in one second.—The effect of these specula was obviously much less than seven times the effect of any one of them. The rays of the sun could fall perpendicularly only on the one in the middle ; and, in consequence of this obliquity of incidence, none of the specula intercepted a column of rays of the same diameter, and the image formed in the focus of each could not be exactly circular.[*]

Burning mirrors, composed of glass, were constructed by M. Zeiher of St Petersburgh. His object was to convert plates of plain glass into concave mirrors, which he effected, by placing the glass upon a convex tool, and exposing it to a strong heat, till it assumed the exact curvature of the tool. Zeiher made numerous trials with plates of various sizes, and, after several failures, he succeeded in finding the proper method of conducting the operation. No particular difficulties occurred in giving the proper shape to plates five or six inches in diameter ; but, in forming one of 16 inches, the circumference was moulded to the tool before the central parts, where a number of vesicles of air had collected ; and, in some other cases, the glasses cracked after they had received the proper shape. The following method is that which Zeiher always found to succeed :

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[*] No account of this burning glass of Sir Isaac Newton's, is given in the *Philos. Trans* and we are informed, upon very good authority, that no such instrument is in the possession of the Royal Society. Mr Derham, however, a Fellow of the Royal Society, gives the same account which we have followed in the text. See Derham's *Astrotheologia*, lib. vii. cap. i. Note.

A small bit of the glass to be used, must first be exposed to the fire till it becomes red hot, and if, after cooling, it has preserved its polish and transparency, the glass is fit for the required purpose, for it sometimes happens that the glass becomes quite black after the operation. The plate of glass is next placed on a concave iron dish of the required curvature, and put into a furnace. Coals are placed below and above the dish, and on all sides of it. The greatest care must then be taken that the glass shall become equally hot both at the circumference and at the centre, for if the red colour should get deeper in the middle, the glass will be in great danger. As soon as the whole is red hot, the instant of its bending to the shape of the mould must be carefully watched, and when this happens, which may be observed from the reflected images of the surrounding coals, all the fire must be removed from above the glass, and also a great part of the fire at its sides. The glass must then be covered with warm ashes, that have been passed through a sieve, and it must be allowed to cool gradually. It is of the utmost importance to mark the precise moment when the glass applies itself to the surface of the mould, for, if it remain too long, a part of the scoriæ, which separates from the mould, will adhere to the glass. When the glass is covered with the hot ashes, the fire must still be allowed to remain below the mould, lest the glass should crack by being cooled too suddenly. When the glass is taken from the furnace, its convex sides may then be silvered for a burning speculum; or, if a lens is required, two of the pieces of glass may be joined, so as to contain a fluid.

M. Zeiher also constructed burning glasses, by making a concave frame of wood, and covering the concave surface with a paste made of flower, chalk, &c. till it had the requisite degree of curvature. A number of pieces of silverized glass mirrors, about half an inch square, were then fixed upon the concave side, so as to constitute a polygonal reflecting surface.

About the same time that Zeiher was occupied with these pursuits, the celebrated Buffon was engaged in the improvement of burning instruments. This distinguished naturalist directed the whole energy of his powerful mind to this curious subject; and when we say that he has in a great measure exhausted it by the ingenuity of his contrivances, we are not detracting much from the merit of his successors.

Before Buffon began to construct his great mirror, he made a number of preliminary experiments, which are well worthy of being recorded. He found that silvered glass reflected light more powerfully than the best polished metals, even than those which are employed for the specula of reflecting telescopes;—that at short distances, such as four or five feet, only one half of the light was lost by reflection;—that almost no light was lost by being transmitted through 100, 200, and 300 feet of air;—that more of the light of candles was lost by reflection than the sun's light, owing to the greater obliquity of the incident rays;—that the image reflected from a plain mirror six inches square, is at a short distance also six inches square, but afterwards it augments, and then grows deformed, till it at last becomes round at greater distances;—that a plain mirror six inches square loses its square figure at the distance of 60 feet, and one of a foot square at the distance of 120 feet;—that a lens 32 inches in diameter and six inches focal length, having the diameter of its focus 8 lines, melted copper in less than a minute, while a small lens 32 lines in diameter, with a focal length of 6 lines, and its focus $\frac{8}{12}$ or $\frac{2}{3}$ of a line, was scarcely capable of heating copper, though the two lenses had theoretically the same burning power, and that a large focus was therefore preferable to a small one, in the fusion of metals. After having determined these preliminary points, Buffon constructed, with the assistance of M. Passemant, a very powerful mirror, which we shall now proceed to describe.

This mirror, which we have represented in Plate CV. Fig. 1., was at first composed of 168 pieces of plain silvered glass, six inches by eight, and having an interval of four lines between each, for the purpose of allowing them a free motion in every direction, and also of permitting the observer to see the place to which the images were to be thrown. These pieces of glass were mounted in an iron frame, and each of them was so fitted up with screws and springs, that a motion could be given to them in any direction, so that the images reflected from all the mirrors might be easily thrown upon the same spot. The machinery for giving motion to each mirror is represented in Fig. 2, 3, and 4. The greatest difficulty experienced in the formation of this mirror, was to obtain glasses sufficiently plane. Buffon selected those that gave the roundest image of the sun at the distance of 150 feet; and he had to examine more than 500 before he could procure 168 that answered his purpose. With this instrument the following results were obtained.

March 23. 1747, Buffon set on fire, at the distance of 66 feet, a plank of tarred beach wood, with 40 mirrors only. In this experiment, the mirror was not put upon its stand, and was therefore very disadvantageously placed, forming with the sun an angle of 20° of declination, and another of more that 10° of inclination.

March 23. 1747. The mirror being still more disadvantageously placed, a plank tarred and sulphured was set on fire at the distance of 126 feet, with 98 mirrors.

April 3. 1747. At 4 o'clock in the evening, when the sun's rays were weak, and his light very pale, and when the mirror was mounted upon its stand, a slight inflammation was produced upon a plank covered with wool cut into small pieces (*laine hachée*) at the distance of 138 feet, with 112 of the mirrors.

April 4. 1747. At 11 o'clock in the morning, when the sun was very pale and obscured with vapours and light clouds, 154 mirrors at the distance of 150 feet, made a tarred plank smoke to such a degree in two minutes, that it would have been inflamed, had not the sun quickly disappeared.

April 5. 1747. At three o'clock in the afternoon, the sun being more feeble than on the day preceding, 154 mirrors, at the distance of 250 feet, inflamed in $2\frac{1}{2}$ minutes chips of fir deal sulphured and mixed with charcoal. When the sun was vivid, the inflammation took place in a few seconds.

April 10. 1747. After mid-day with a clear sun, 128 mirrors, at the distance of 150 feet, set fire to a tarred plank of fir. The inflammation was very sudden, and took place over the whole extent of the focus, which was about sixteen inches in diameter.

April 10. 1747. At half past two o'clock, 148 mirrors, at the distance of 150 feet, set on fire a plank of beech sulphured in some parts, and covered in others with wool cut into small portions. The inflammation, which began in the uncovered part of the wood, was so sudden and violent, that it was necessary to plunge the plank in water in order to extinguish it.

April 11. 1747. Twelve mirrors at the distance of

20 feet inflamed small combustible matters. Twenty-one mirrors inflamed a plank of beech that had been already partly burned. Forty-five mirrors at the same distance, melted a large pewter flask that weighed about six pounds. One hundred and seventeen mirrors melted some thin pieces of silver, and made red hot a piece of sheet iron. By employing all the mirrors, Buffon imagined that he could melt metals as easily at 50 feet distance as at 20.

From a number of subsequent experiments, Buffon ascertained that 40 or 45 feet was the most advantageous distance for making experiments on the metals. The silver plates which he melted at this distance with 224 glasses emitted a most abundant smoke, but as they were very clear, he did not ascribe this smoke to grease or any other substances which they had imbibed, as was supposed by some who had witnessed the experiment. When the silver was quite new, it smoked as before, and sometimes for about eight or ten minutes before it was melted.

At a subsequent period, Buffon burned wood at the distance of 200 and 210 feet, when the sun was brilliant, and he melted all the metals and metallic minerals at the distance of 25, 30, and 40 feet. The mirror requires about half an hour to be properly adjusted, so that all the images may coincide; but when the adjustment is completed, the focus will continue unaltered for more than an hour.

The attention of Buffon was next directed to the construction of mirrors for burning at short distances. He took circular plates of glass about 18 inches, two feet, and three feet in diameter, and having perforated them at the centre with an aperture two or three lines in diameter, he placed them in a circle of iron that was truly turned. A very fine screw connected with a box stretching across the back of the glass, passed through the hole in the centre into a nut on the other side, so that by turning the screw, the circular piece of flat glass was gradually incurvated, till it formed a concave mirror. The glass of three feet diameter, when it was bent about $\frac{5}{8}$ths of a line, had its focus 50 feet distant, and set fire to light substances; when it was bent two lines, it burned at the distance of forty feet; and when it was bent $2\frac{3}{4}$ lines, its focal length was 30 feet; but in attempting to reduce its focal length to 20 feet, it was broken in pieces. The glass of two feet diameter shared the same fate; but the one of 18 inches, which had a focal length of 25 feet, was preserved as a model of this species of mirror. The accident which happened to the two largest of these mirrors, appears to have been owing to the perforation in the centre. In order to remedy this evil, Buffon proposed to place a circular piece of glass at the extremity of a cylindrical drum, made of iron or copper, and completely air-tight. The cavity being exhausted by means of an air-pump, the glass at one extremity would be pressed in by the weight of the atmosphere, and would have its focal length inversely proportional to the degree of rarefaction. This contrivance is represented in Plate CV. Fig. 5, and a section of it in Fig. 6.

A still more simple and ingenious method of exhausting the air in the drum was contrived by Buffon. He proposed to grind the central part of the plain glass into the form of a small convex glass, and in the focus of this convex portion to place a sulphur match, so that when the mirror was directed to the sun, the rays concentrated by the convex portion would inflame the match, which, being set on fire, would absorb the air, and thus produce a partial vacuum, and consequently an incurvation of the plain glass.[*] See Plate CV. Fig. 7 and 8.

Mirrors of this kind, with a moveable focus, were regarded by Buffon as of great use for measuring the effects of the solar rays, when concentrated into foci of different sizes. As the quantity of incident light and heat is nearly the same to whatever curvature the glass is successively bent, we might thus determine the size of focus by which a maximum effect was produced.

Buffon likewise made a number of concave mirrors, by bending plates of glass on moulds of a spherical form. Some of these were so large as 3, 4, 4 feet 6, and 4 feet 8 inches in diameter; but the utmost care is requisite in the formation of those of such a large diameter. After these glasses were moulded to the proper shape in appropriate furnaces, their concave and convex sides were carefully ground so as to be perfectly concentric, and the convex side was afterwards silvered by M. de Bernieres. Out of twenty-four mirrors of this kind which Buffon had moulded, he was able to preserve only three, the rest having broken, either by exposure to the air, or in the operation of grinding. One of these three, which was 46 inches in diameter, was presented to the king of France, and was regarded as the most powerful burning mirror in Europe. The other two were 37 inches in diameter, and one of them was deposited in the Cabinet of Natural History in the Jardin du Roi. Buffon concentrated the rays of the moon by means of the mirror of 46 inches diameter, but, though his thermometer was very sensible, no heat was perceived.

The great defect in the large burning mirror of Buffon, and, indeed, in every combination of plain mirrors, is the difficulty of adjusting each mirror, so as to be always perpendicular to the straight line which bisects the angle formed by the ray of the sun, and the line which joins the mirror and the focus of the paraboloid. The necessary motion might easily be given to all the elementary mirrors, by attaching each of them to a machine resembling the Heliostata of Gravesende; but the dilatation of its parts, and the shakings to which it would inevitably be exposed, might occasion an agitation in the different images, which would greatly diminish the power of the machine. The only method, therefore, of combining plain mirrors, is to confide each of them to an individual, properly instructed, to keep it in such a position as to reflect the solar rays to a determinate point, and to vary this position according to the motion of the sun. M. Peyrard, however, properly observes, that though this might be easily done by three or four persons, yet if 100 or 200 individuals were thus employed, none of them could distinguish the image of his own mirror from that of the rest; and, therefore, if a single image were removed from the focus, each of the mirror-holders would naturally wish to know if it was his, and a general agitation and confusion of the images would be the consequence. In order to remedy this inconvenience, M. Peyrand proposes to furnish each mirror with suitable apparatus, so that, when it is once directed to the point where the images are to be collected, the individual who has the charge of it can always adjust it to the motion of the sun, without looking beyond the apparatus itself.

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[*] Instead of grinding the central part of the glass plate into a convex form, Zeiher proposes that a small burning glass should be applied to inflame the sulphur; or, what is still better than either of these plans, a convex lens might be fastened by the balsam of Tolu, or any transparent cement, to the centre of the glass plate.

M. Zeiher employed a more effectual method of bending circular plates of glass, than that which was used by Buffon. The circular piece of glass was placed in an iron ring, across which was fixed a thin piece of iron, with a hole containing a female screw, so placed as to be above the centre of the glass. A strong bar of brass was also placed across the centre of the speculum, and a screw working in the centre of this, and in the female screw already mentioned, pressed the thin iron bar against the glass, and bent it into the proper curvature. A plate of Venetian glass, two lines thick and twenty Rhinland inches in diameter, was bent in this way till it protruded two lines in the middle, so as to have a focal length of fifteen feet, which was a greater curvature in proportion than any of Buffon's. The glass was kept in this state for several days, without suffering any injury. See *Nov. Comment. Petrop.* 1758, 1759, page 250, Note.

The apparatus with which each mirror is connected, is represented in Plate CV. Fig. 9, where AB is a common telescope, with only one tube, containing the object-glass at B, and the eye-glass at A. This tube is moveable on its axis, between the two collars CC, C′C′, which are fixed to a piece of metal DD. This piece of metal is supported on a stand like a common telescope, having a vertical and horizontal motion, by which the axis of the telescope may be directed with facility to any given point. The axis of the instrument is marked out by the intersection of a pair of cross-wires placed in the anterior focus of the eye-glass; and when this point of intersection is directed to any object, the whole instrument is kept steady in its place by the screws F and G, the former of which prevents any motion in a vertical direction, and the latter in a horizontal direction. From the middle of the tube AB rises a cylindrical piece of metal MM, and upon the eye-glass extremity a branch of iron HHH, wrought square, is fixed firmly in a direction parallel to the axis of the cylindrical piece MM.

A plain silvered glass mirror IL, inserted into a proper frame, is made to turn on two pivots, one of which *m m* rests on the cylinder MM, while the other *o o* is inserted in the horizontal part of the branch HH. The straight line which passes through the centres of these pivots, must be exactly parallel to the silvered back of the mirror, and at right angles to the axis of the telescope, and the black mark N, produced by a scratch upon the silvered surface, must be bisected by the axis of the mirror.

Above the object end B of the tube is fixed a plate of metal, seen in the figure, and behind this plate is seen another square plate *z z*, on which are drawn the lines *x x*, *y y*, crossing each other at right angles. By means of a piece of brass fixed to the last of these plates, and traversing a square hole made in the other plate, the square plate may be moved up and down, and from right to left; and it is kept in any position which is thus given to it, by a screw on the back of the fixed plate. The moveable square plate must be adjusted in such a manner that the line *x x* may intersect the axis of the telescope, and be parallel to the axis *o m* of the mirror. The position of the line *yy* must also be such, that its distance from the axis of the telescope is equal to the distance of the line IK from the same axis. When the plate *z z* is thus adjusted, the straight line *y y* will always be in the same plane with the line IK, whatever be the position of the mirror, and a line drawn from a point at N, where the axis of the mirror cuts IK, to the point where *y y* intersects *x x*, will be parallel to the axis of the telescope.

The spring QQ′ is fixed at Q to the arm HH, and by a screw R working into its other extremity Q′, the end H of the horizontal arm may be made to press the pivot *o o* upon the frame of the mirror.

The horizontal branch HH, which is represented separately in Plate CV. Fig. 10, is surrounded with several pieces. The piece *d b* and pivot *o* are fixed in an invariable manner. The pivot *o o* is inserted in a square hole through the piece VV, and through the extremity of the arm HH. The piece *d b* may be moved either before or behind, by turning the screw: and the piece VV may be moved from right to left with the piece *d b*, by means of the screw S.

The apparatus being thus constructed, the next thing to be considered is the method of adjusting it. In order to effect this, the axis of the mirror must be perpendicular to the axis of the telescope; the line drawn from a point near N, where the axis of the mirror cuts the line IK, to the point of intersection of *x x* and *y y*, must be parallel to IK, and the straight line *y y* must always be in the same plane with IK.

The mirror is first placed in such a manner that the line IK is at right angles to the axis of the telescope. By turning the screw T, the lower edge of the frame is made a tangent to the circular surface MM′, which is parallel to the axis of the telescope. The screw T is then turned, in order to fix the piece *d b* in an invariable manner.

The axis of the telescope is next directed to a point on a plane surface, placed at a certain distance. This point must be situated in a vertical plane, perpendicular to the plane surface, and passing through the eye of the observer and the centre of the sun. A horizontal line being drawn through this point, a second point is taken, as far from the first as the centre of the mirror is distant from the axis of the object-glass. By unscrewing S, turning the telescope on its axis, and the mirror also about its own axis, the piece VV is moved backwards or forwards until the centre of the reflected image falls upon the second point. The square plate *z z* is then adjusted in such a manner that the shadow of the line IK falls on the line *y y*, and that the shadow of NN is bisected by the line *x x*. When this happens, the plate *z z* is firmly fixed. Hence it follows, that whenever this adjustment is made, and when the intersection of the cross wires in the telescope is directed to any point, the rays reflected by the mirror will be parallel to the axis of the telescope, and will always continue so while the shadow of IK falls on *yy*, and while the shadow of NN is bisected by *x x*.

In making use of the mirror, the intersection of the cross wires must be first directed to any point of the object which is to be inflamed:—the telescope must next be turned round in the collars CC, C′C′, till the shadow of the line IK falls upon *y y*; and, finally, the mirror must be turned about its own axis till the shadow of NN is bisected by the line *x x*. The centre of the reflected image will consequently fall upon a point of the object as far distant from the point to which the intersection of the wires was directed, as the centre of the mirror is from the axis of the telescope. The image may obviously be preserved in this position as long as we choose, by keeping the shadows of IK and N in the same position.

In this manner M. Peyrard proposes to construct every individual mirror, so that if each of them is managed by one person, and directed to the same point, the heat of the solar beams may be multiplied to any extent. As the motion of the sun, and consequently the change of position in the image, is very slow, one person may direct ten or more of the mirrors, without any injurious enlargement of the focus.

If the object required to be burnt is in motion, each mirror must be managed by two persons, one of whom is constantly employed in directing the intersection of the wires upon the moving object, while the other takes care that the shadows of IK and N shall fall upon their proper places.

The attention of M. Peyrard was next directed to the effects which might be expected from any given combination of mirrors; and the following are the data upon which he proceeds. They are derived, from the experiments of Buffon.

1. The light of the sun reflected by a plane glass mirror, does not lose more than one half by reflection at short distances.

2. At great distances it loses almost none of its force, from the thickness of the air through which it passes; and,

3. Its force is diminished solely by the inverse ratio of the augmentation of the spaces which the image occupies upon a plane perpendicular to the reflected rays.

From these principles, and from the consideration that the rays reflected from a circular piece of mirror on a line perpendicular to its surface, form a cone whose angle is 32′ the diameter of the sun, M. Peyrard has computed the distances at which the reflected image of a mirror five decimetres[*] in diameter, is doubled, tripled, quadrupled, thus:

The image being	The distance in Metres is
Double	22,25
Triple	39,33
Quadruple	53,72
Quintuple	66,41
Sextuple	77,86
Septuple	88,41
Octuple	98,22
Nonuple	107,44
Decuple,	116,16

If these distances were double, triple, quadruple, the diameters of the mirrors, instead of being five would be ten, fifteen, twenty, &c. decimetres.

It follows from the preceding table, that if any given combination of mirrors produced a certain degree of heat at a small distance, in order to produce the same degree of heat at the distance of 22,25 metres, double the number of mirrors would be required; at the distance of 39,33 metres, triple the number would be required, and so on.

From an examination of Buffon's experiments, M. Peyrard has obtained the following results, respecting the multiplication of the direct heat of the sun, which is necessary to burn different substances.

1. On the 23d of March, at noon, a plank of tarred beech-wood was set on fire by $4\frac{1}{2}$ times the direct heat of the sun.

2. On the 10th of April, in the afternoon, a tarred plank was set on fire by $4\frac{4}{15}$ the sun's heat.

3. On the 11th of April, a beech plank, partly burned, was set on fire by $5\frac{1}{4}$ times the sun's heat.

4. On the same day, some small combustible substances were burnt by three times the sun's heat.

5. On the same day, a large pewter flask, weighing 6 pounds, was melted by $11\frac{1}{4}$ times the sun's heat.

6. Some thin pieces of silver were melted, and a piece of sheet iron was made red hot, by $29\frac{1}{4}$ times the sun's heat.[†]

7. Silver plates melted with $37\frac{1}{2}$ times the sun's heat.

By supposing that *five* times the heat of the sun is sufficient to set fire to tarred planks, Peyrard imagines that *eight* times the sun's heat will be sufficient to set on fire all kinds of wood, and upon this principle he has computed the following table, suited to his own mirrors of five decimetres in diameter.

At the distance of	It would require to set fire to wood
22,25 metres	16 mirrors
39,33	24
53,72	32
66,41	40
77,86	48
88,41	56
98,22	64
107,44	72
116,16	80
1250, or a quarter of a league	590
2500, or half a league	2262

In order to find the number of mirrors x necessary for burning wood at any distance d, we have the following analogy:

$$53.72 : 53.72 + d = 1 : x^2, \text{ and}$$

$$x = \sqrt{\frac{(53.72 + \mathrm{d})^2}{(53.72)^2}}.$$

By making the height and breadth of the mirrors double, triple, quadruple, &c. it is obvious that they would inflame wood at double, triple, and quadruple distances. M. Peyrard is of opinion, that with 590 glasses five decimetres in diameter, he could reduce a fleet to ashes at the distance of a quarter of a league; that if they were a metre in diameter, he could produce the same effect at the distance of half a league; and that if they were two metres in diameter, the same result would be obtained at the distance of a league. In this calculation, however, M. Peyrard has completely omitted to take into account the great diminution of effect which must necessarily arise from any deviation in the surfaces of the mirrors, from a perfectly plain figure, and from a want of parallelism in the surfaces. Even if all the mirrors were parallel glasses ground with the same care as those which are used for reflecting instruments, the diminution of effect would be enormous at the distance of a league, as the angular deviation increases exactly with the distance. An experimental proof of this operation may be obtained, by looking into a mirror at different distances

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[*] We have not converted the French into English measure, as it is only the ratio of the numbers that is of any use.

[†] This result enables us, in some measure, to estimate the accuracy of these deductions. As only *thin* pieces of silver were melted, we are entitled to say, that the heat did not much exceed 22° of Wedgwood, or 3940° of Fahrenheit, the temperature at which silver melts, according to Sir James Hall's experiments. But $\frac{3940^\circ}{29\frac{1}{4}} = 135^\circ$, which is obviously too great a result for the heat of the sun. If the heat of the solar rays were 90° in April, which is a sufficiently high estimate, we have $\frac{3940^\circ}{90^\circ} = 44$, the number of times that the sun's heat appears to have been increased by supposing the temperature to be 3940°.

At a short distance the worst mirror will give a tolerable representation of the observer, but as the distance increases, the distortion becomes very great. Even in the finest mirrors that are now made as articles of furniture, we are confident that the image will be very perceptibly distorted at the distance of 50 feet. This cause is, we fear, the most insurmountable obstruction to the process of burning objects at a great distance. By a numerous combination of large mirrors, it may be possible to inflame wood, at the distance of a quarter of a mile; but we think that this is the greatest distance at which effects of this kind will ever be produced.

Having thus given a full account of the various catoptric burning instruments which have been constructed, we shall conclude this part of the article with some general remarks.

In the present state of military science, it is very obvious that burning instruments can never be employed as an engine of war; and therefore any attempt to construct mirrors for burning at a distance must be considered more as a matter of curiosity than of use. The formation of instruments, however, for burning at short distances, is a subject of the first importance to science; and we have no doubt that they will, some time or other, be employed as the most powerful agents in chemistry and the arts. Though catoptric burning instruments of great power have been constructed, yet their effects have never been so great as those of lenses, and they are besides liable to numerous disadvantages. The burning point must evidently lie between the centre of the mirror and the sun; and therefore the operator cannot so easily perform his experiments as when the focus lies on the other side of the instrument. All his operations, indeed, have a tendency to obstruct the light before it falls upon the reflecting surface. This evil will not admit of a remedy, and consequently we must have recourse to instruments of a dioptric or catadioptric nature, which are alone capable of uniting great power with great facility of management.

ON DIOPTRIC BURNING INSTRUMENTS.

There is reason to believe that the ancients were acquainted with the use of burning lenses, though the information upon this point which has been conveyed to our times is extremely trifling. All that we know on the subject, indeed, is contained in Pliny and Lactantius. The former of these authors mentions globes of glass and crystal, which, when exposed to the sun, burnt the clothes and flesh on people's backs; and Lactantius observes, that a sphere of glass filled with water, and held in the sun, lighted the fire, even in the coldest weather.

The first burning lenses of any magnitude were constructed by M. Tschirnhausen. They were three and four feet in diameter, their focal length was about twelve feet, and the diameter of the focal image about an inch and a half. In order, however, to increase the force of the solar rays, the light refracted by the large lens was received upon a lens of a smaller size, which converged them to a point nearer the large lens than its principal focus, and had a focal image of only 8 lines in diameter. The large lens, which weighed 160 pounds, was purchased by the Duke of Orleans, and presented by him to the French Academy. As its effects were extremely powerful, we shall give them at some length.

1. All sorts of wood, whether hard or green, and even when wet, were burnt in an instant.

2. Water in a small vessel boiled immediately.

3. All the metals, when the pieces were of a proper size, were easily melted.

4. Tiles, slates, delft ware, pumice stone, talc, whatever was their size, grew red and vitrified.

5. Sulphur, pitch, and resins, melted under water.

6. When the metals were placed in charcoal, they melted more readily, and were completely dissipated.

7. The ashes of wood, vegetables, paper, and cloth, were converted into a transparent glass.

8. All the metals were vitrified upon a plate of porcelain. Gold received a fine purple colour.

9. Substances that would not melt in pieces were easily melted in powder; and those that resisted the heat in this form, melted by adding a little salt.

10. A substance easily fused assists in melting more refractory substances when placed along with them in the focus; and it is very singular, that two substances which are very difficult to melt separately, are very easily melted when exposed together, such as flint and English chalk.

11. A piece of melted copper being thrown suddenly into cold water, produced such a violent concussion that the strongest earthen vessels were broken to pieces, and the copper was thrown off in such small particles that not a grain of it could be found. This did not happen with any other metal.

12. All bodies except the metals lose their colour. The precious stones are instantly deprived of it.

13. Certain bodies vitrify easily, and become as transparent as crystal; but by cooling they grow as white as milk, and lose all their transparency.

14. Other bodies, that are opaque when melted, become beautifully transparent when they are cooled.

15. Substances that are transparent, both when melted and cold, become opaque some days after.

16. Substances which the heat renders at first transparent, but which afterwards become opaque by being melted with other substances that are always opaque, produce a beautiful glass, always transparent.

17. The rays of the moon concentrated by this lens, though extremely brilliant, have no heat.

M. De Buffon, whose burning mirrors have already been noticed, directed his attention also to the construction of burning lenses. His first object was to form burning glasses, by combining two circular segments of a glass sphere, so as to form a lenticular cavity to be filled with water. These glass segments were first moulded into their proper shape, and then regularly ground on both sides, so that the concave and convex surfaces were exactly parallel. The one which he constructed was 37 inches in diameter, with a focal length of about 5 feet and a half, and the segments were of considerable thickness, to prevent them from breaking or altering their form by the weight of the included water. As the refractive power of water is very small, Buffon proposed to increase it by saturating it with salt; but notwithstanding every precaution, he found that the focus of lenses of this kind was never well terminated, nor reduced to its smallest size, and that the different refractions which the rays sustained, produced a very great degree of aberration. Buffon also proposed to make each segment consist of a number of smaller segments put together into a frame; but as the water could not easily be prevented from insinuating itself between the joints of the segments, and as there would be a great difficulty in arranging them in the same spherical circumference, this kind of burning glass does not seem to have ever been executed.

In order to avoid the great thickness of glass at the centres of large convex lenses, Buffon has proposed a very ingenious contrivance. Instead of making the burning lens of one piece of glass, he proposes to form it of three concentric circular pieces resting upon each other. Thus if the whole diameter of the lens is to be 24 inches, which would require a central thickness of three inches if it were of solid glass, the middle part will be a lens 8 inches in diameter, with a thickness of one inch. This lens is inserted in the middle of a circular zone, whose diameters are 8 and 16 inches, and this circular zone is again inserted in the middle of another circular zone, whose diameters are 16 and 24 inches. The surfaces of the lens and of the two zones are all ground to the same radius; so that when they are placed together, the solar rays will be refracted to one focus, in the very same manner as if they had fallen upon a lens 24 inches in diameter. The great advantages which are gained by this construction, is the diminution of the quantity of glass, as it does not require half as much as is necessary in lenses of one piece. In consequence of this diminution of thickness, the power of the lens is remarkably increased. The rays which fall upon the central parts, instead of being absorbed by the great mass of glass through which they had to pass, will be transmitted through the lens of 8 inches, and will be twice as powerful as if they had been refracted by a similar portion of a solid and continuous lens.

The next burning lens of any magnitude was constructed by M. Bernieres for M. Trudaine de Montigny, an honorary member of the Royal Academy of Sciences. This gentleman, whose liberality and zeal deserve to be recorded, engaged to be at the expence of a large burning glass, formed under the direction of several commissioners named by the Academy. This lens consisted of two spherical segments 8 feet radius and 8 lines thick. The lenticular cavity was 4 feet in diameter, and 6 inches and 5 lines thick at the centre, and was filled with spirits of wine, of which it held no less than 140 pints. The focal length of a zone at the circumference, about 6 or 7 lines broad, was 10 feet 0 inches and 6 lines, the focal length of a portion at the centre, about 6 inches in diameter, was 10 feet 7 inches and 5 lines, and the diameter of the focus was 14¾ lines. When the whole surface was covered, except a zone at the circumference of 6 or 7 lines, the following were the foci of the different rays:

	Feet.	Inch.	Lines.
Violet	9	6	4½ from the centre of the lens.
Blue	9	7	10½
Yellow	10	2	3
Orange	10	2	10
Red	10	3	11½

The following experiments were made in October 1774, in the Jardin de l'Infante, by M. M. Trudaine, Macquer, Cadet, Lavoisier, and Brisson, the commissioners appointed by the Academy.

1. The burning power of the anterior half of the lens was much greater than that of the exterior half.

2. On the 5th of October, after mid-day, the sky not being very clear, two farthings, placed upon charcoal, were completely melted in half a minute.

3. In order to melt forged iron, it was found necessary to concentrate the rays by a second lens 8½ inches diameter, 22 inches 8 lines in focal length, and placed at 8 feet 7 inches from the centre of the great lens. At this place, the cone of rays was 8 inches in diameter, and the burning focus, now reduced to 8 lines in diameter, was 1 foot from the small lens.

4. In the focus of the small lens, upon a piece of hollow charcoal, small pieces of forged iron were placed, which were instantly melted. After fusion, the metal bubbled up, and fumed like nitre in fusion, and then sent off a great number of sparks. This effect (which was observed during the experiments with Tschirnhausen's lens,) always took place after the fusion of iron, forged iron, or steel.

5. In order to try the effect upon greater masses, pieces of forged iron, and the end of a nail, were exposed to the focus, and were melted in 15 seconds. A piece of nail, 5 lines long and ¼ of a line square, which was added to the rest, was instantly fused, and the same was the case with a screw that had a round head, and was 8 lines in length.

6. Some days afterwards, a bar of steel, 4 inches long, and 4 lines square, was exposed, so as to receive the focal image upon the middle of its length. This part was completely melted in 5 minutes, after having begun to run at the end of the second minute.

7. Platina, in grains, appeared to draw together, to diminish in bulk, and to prepare for fusion. A little after, it bubbled up and smoked. All the grains were united into one mass, without however forming a spherical button like other melted metals. After the platina had undergone this semifusion, it was not attracted by the magnet as it was before the operation.

8. A portion of platina, deprived of the iron which it contained, and therefore not affected by the magnet, lost a part of its bulk, smoked, and formed one mass, which was extended under the hammer.*

9. Several experiments were made, in order to find the lens that was most proper for collecting the rays after refraction by the large lens. A spirit of wine lens 2 feet in diameter and 4 feet focus, a solid lens 18 inches diameter and 3 feet focus, and another 13 inches in diameter, were successively tried, but none of them produced such a powerful effect as the lens 8½ inches in diameter, and 22 inches and 8 lines focus, though it was full of vesicles and striæ.

Messrs. Cadet and Brisson made a number of experiments on the refractive power of different fluids, by inclosing them in the lens of M. Trudaine, and observing the variations in its focal length. The object of their experiments was to find a fluid that possessed a greater refractive power than spirits of wine, and was at the same time sufficiently cheap and transparent to be used between the glass segments. Liquid turpentine was the most refractive fluid that they employed; but as they found that its dispersive power was to that of crown-glass as 34 to 28, this fluid was obviously, on this account, unfit

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[*] Messrs Macquer and Beaume are said to have melted small grains of platina by a concave glass, 22 inches in diameter, and 28 inches focus.

for the purpose.[*] The fluid which they preferred was a saturated solution of sal ammoniac or distilled water.

The most powerful burning-glass that has yet been constructed, was made by Mr Parker of Fleet-street. After a great number of experiments, and an expence of above 700*l.*, this able artist succeeded in completing a burning lens of flint glass three feet in diameter. This powerful instrument is represented in Plate CVI. Fig. 1. The large lens, which is placed in the ring at A, is doubly convex, and when fixed in its frame, it exposes a surface of 2 feet $8\frac{1}{2}$ inches. It is $3\frac{1}{4}$ inches thick at the centre; its focal distance is 6 feet 8 inches; the diameter of the burning focus one inch; and the weight of the lens 212 pounds. The rays that were refracted by this lens, were received (according to the method of Tschirnhausen) upon a second lens B, whose diameter is 16 inches out of the frame, and 13 inches in the frame; its central thickness is $1\frac{5}{8}$ of an inch. The length of its focus is 29 inches, the diameter of the focal image $\frac{1}{8}$ of an inch, and the weight of the lens 21 pounds. The combined focal length of these lenses is 5 feet 3 inches, and the diameter of the focus half an inch. These lenses are placed at the extremities of a truncated conical frame, consisting of twelve ribs of wood. Near the smaller end B is fixed a rack D, which passes through the pillar L, and is moveable by means of a pinion within the pillar, driven by the handle E. A bar of wood F, fixed at G between the two lower ribs of the cone, carries an apparatus H, which turns on an universal joint at K, and also moves to or from F in a chased mortice. This apparatus, which carries the iron plate I for holding the substances to be examined, may thus be placed exactly in the focus of the lens B. The conical framing is supported by pivots upon a strong iron bow AC, which rests upon a mahogany frame LL, with three feet MMM furnished with castors. Friction wheels are placed under the table N, to facilitate the horizontal motion.

The following experiments with this lens were made in the presence of major Gardner, and of several members of the Royal Society.

Substances fused, with their weight and time of fusion.	Weight in grains.	Time in seconds.
Common slate,	10	2
Scoria of wrought iron,	12	2
Gold, pure,	20	3
Platina, do.	10	3
Nickel,	16	3
Cast iron, a cube,	10	3
Silver, pure,	20	4
Crystal pebble,	7	6
Terra ponderosa, or barytes,	10	7
Lava,	10	7
Asbestos,	10	10
Steel, a cube,	10	12
Bar iron, do.	10	12
Garnet,	10	17
Copper, pure,	33	20
Onyx,	10	20
Zeolites,	10	23
Pumice stone,	10	24
An oriental emerald,	2	25
Jasper,	10	25
White agate,	10	30
Flint, oriental,	10	30
A topaz or chrysolite,	3	45
Common lime-stone,	10	55
Volcanic clay,	10	60
Cornish moor stone,	10	60
White rhomboidal spar,	10	60
Rough cornelian,	10	75
Rotten stone,	10	80

A diamond of 10 grains, when exposed to the lens for 30 minutes, was reduced to 6 grains. It opened, foliated, and emitted whitish fumes, and when again closed, it bore a polish, and kept its form.

Gold retained its metallic state, though exposed for many hours.

The specimens of platina were in different states of approach to a metallic form.

Copper did not lose any of its weight after an exposure of three minutes.

Iron steel shear melted first at the part in contact with the charcoal, while the other part exposed to the focus was unfused.

Iron scoria melted in much less time than the turnings of iron.

Calx of iron from vitriolic acid, precipitated by mild fixed alkali, weighed 5 grains before exposure, and $5\frac{1}{4}$ after it.

The remains of regulus of zinc, after it had melted and was nearly evaporated, were magnetic.

Regulus of cobalt was completely evaporated in 57″.

Regulus of Bismuth, exposed in charcoal, was nearly evaporated:—in black lead it began to melt in 2″, and was soon after completely fused: Iron, on exposure of 180″, lost only half a grain; when placed on bone ash, it fused in 3″.

Regulus of antimony, 33 grains, on charcoal, were fused in 3″, and 11 grains only remained after 195″.

Fine kearsh from the cannon foundery evaporated very fast during 120″, and 30″ afterwards the remainder flowed in globules, which were attracted by the magnet when cold.

Crystal pebble of North America, five grains, contracted in 15″, were perfectly glazed in 135″, ebullesced in 150″, and became of a slate colour, and semitransparent.

Agate, oriental flint, cornelian, and jasper, were rendered externally of a glossy form.

Garnet, placed upon black lead fused in 120″. It became of a darker hue, lost one-fourth of a grain, and was attracted by the magnet. Ten cut garnets from a bracelet run into one another in a few seconds.

Mr Wedgewood's pyrometrical clay run into a white enamel in a few seconds. Other seven kinds of clay sent by that gentleman were vitrified.

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[*] Cadet and Brisson, in the course of their experiments, were led to the discovery of achromatic fluid object-glasses, a discovery which has hitherto been referred to a much later date. This discovery is most distinctly contained in the following passage.—"Comme la terrebinthe cause un dispersion de rayons assez differente de celle que cause le verre, comme nous, nous en sommes assurés par l'experience, ne pourroit on pas faire des objectifs dans lesquels, pour les rendre achromatiques, on feroit usage de cette resine, a la place du flint-glass, matiere si difficile a se procurer d'une densite uniforme, et sans defauts, surtout en grands morceax, mais le developpement de cette idée nous meneroit trop loin, et ne fait pas partie de notre sujet actuel!" *Mem. Acad. Par.* 1777, page 551.

Limestone was sometimes vitrified and sometimes agglutinated. A globule from one of the specimens flew into a thousand pieces when put into the mouth.

Stalactites zeolithus spatosus, nine grains, took a globular form in 60″. The globule began to become clear in 148″. It became perfectly transparent in 155″ When cold, its transparency diminished, and it assumed a beautiful red colour.

Lavas and other volcanic products likewise yielded to the power of this lens.

In the year 1802, Sir Joseph Banks, Dr Crawford, and some other members of the Royal Society, were present at an experiment for concentrating the lunar rays; but though the most sensible thermometers were applied, it was rather thought that there was a diminution than an increase of heat.

It was not to be expected that this powerful lens, which cost such a large sum of money, could have been retained in the hands of Mr Parker. That ingenious artist was naturally desirous to indemnify himself for the expense of its construction. A subscription was therefore opened for purchasing the lens, as a national instrument; but, to the disgrace of our country, this subscription completely failed, and Mr Parker was induced to sell it to Captain Mackintosh, who accompanied Lord Macartney to China. This valuable instrument was left at Pekin, where it remains, a monument of Chinese ignorance, and British parsimony.

From the history which we have now given of dioptric burning instruments, it evidently appears, that in every construction which has yet been proposed, a limit is necessarily put to the magnitude, and consequently to the power of burning lenses. The extreme difficulty of procuring glass proper for a large solid lens; the trouble and expence of casting it into a lenticular form without faults and impurities; the great increase of central thickness which becomes necessary by increasing the diameter of the lens; the enormous obstruction which is thus opposed to the transmission of the solar rays; and the augmented aberration which dissipates the rays at the focal point; are almost insuperable obstacles to the construction of a solid lens of a size larger than that of Mr Parker.

Buffon, indeed, has very ingeniously removed one of these difficulties, by his proposal to construct the lenses of three concentric zones. The quantity of glass is obviously diminished by this contrivance, and the obstruction of the rays in passing through the central portions of the lens is greatly lessened; but the outer circular zone must still contain as much glass as the corresponding zone in the solid lens, and must be nearly as difficult to cast and grind as if it formed a part of the whole lens.

In order to remove these evils, and at the same time to diminish the expence and simplify the construction of dioptric burning instruments, the following construction has been proposed by Dr Brewster. If it be required, for example, to construct a burning lens 4 feet in diameter, it should be composed of different pieces, as represented in Plate CVI. Fig. 2, where ABCD is a lens of flint glass, 18 inches in diameter. This lens is surrounded by several segments, AGID, AGEB, BELC, CLID, ground in the same tool with ABCD, but so formed with respect to their thickness at AB and GE, &c. that they may exactly resemble the corresponding portions of a solid lens. These different thicknesses can be easily calculated, and there is no difficulty in giving the segments their proper form. This zone, consisting of separate segments, is again surrounded with other segments, GNOF, FOEP, PEMQ, QMLR, RLKS, SKIT, THIV, VHGN, each of which is six inches broad in the direction of the radius. The section of this lens is represented in Fig. 3. where DE is the central portion, DCn, EoF the second zone, and CAm, FBp the external zone. One of the segments is shewn separately in Fig. 4. By this combination of segments, a lens four feet in diameter will be formed, and will obviously possess the same properties as if it consisted of solid glass. The advantages of this construction may be very shortly enumerated.

1. The difficulty of procuring a mass of flint glass proper for a solid lens, is in this construction completely removed.

2. If impurities exist in the glass of any of the spherical segments, or if an accident happens to any of them, it can be easily replaced at a very trifling expence. Hence the spherical segments may be made of glass much more pure and free from flaws and veins than the corresponding portions of a solid lens.

3 From the spherical aberration of a convex lens, the focus of the outer portion is nearer the lens than the focus of the central parts, and therefore the solar light is not concentrated in the same point of the axis. This evil may, in a great measure, be removed in the present construction, by placing the different zones in such a manner that their foci may coincide.*

4. A lens of this construction may be formed by degrees, according to the convenience and means of the artist. One zone, or even one segment, may be added after another, and at every step the instrument may be used as if it were complete. Thus in Fig. 2. the segment NV$v\,n$ may be added to the lens without the rest of the zone to which it belongs, and it will contribute, in the proportion of its area, to increase the general effect.

5. If it should be thought advisable to grind the segments separately, or two by two, a much smaller tool will be necessary than if they formed one continuous lens. But if it should be reckoned more accurate to grind each zone by itself, then the various segments may be easily held together by a firm cement.

6. Each zone may have a different focal length, and may therefore be placed at different distances from the focal point, if it is thought proper.

In the construction of burning lenses, whether they consist of one solid piece or of a number of zones and segments, a limit is necessarily put to their magnitude. As we increase the diameter of these lenses, the surface of the outer zone has a more oblique position towards the incident rays, and, consequently, a greater number of them are reflected from that surface. When this obliquity amounts to 47° or 48°, the whole of the incident light is reflected, and, therefore, a zone of this obliquity becomes totally useless. The diameter of burning lenses can never exceed the chord of an arch of 47° or 48° of the sphere to which it has been ground; and when the diameter approaches to this limit, the outer zone contributes very little to the general effect. In order to surmount this difficulty, we must have recourse to Catadioptric Instruments.

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* The burning focus lies a little beyond the red rays, and therefore at a greater distance from the lens than the luminous focus.

ON CATADIOPTRIC BURNING INSTRUMENTS.

In order to construct a burning instrument which shall in a great measure, be unlimited in its power, we must combine the principles both of reflection and refraction. We are not aware that any instrument of this kind has ever been proposed; and we are the more surprised at this, as the proper combination of lenses and mirrors must naturally suggest itself to any one who considers the limits which are set to the construction of single lenses, and the disadvantages either of a theoretical or a practical nature, to which they are liable.

This instrument, which has been proposed by Dr Brewster, and which may be properly called a burning sphere, from the arrangement of the lenses, is represented in Plate CVI. Fig. 5. which is merely a section of the sphere, and represents only five of the lenses, and four of the mirrors. The lenses A, B, C, D, E, which may be of any diameter and focal length, are so placed in the spherical surface AMN, that their principal foci exactly coincide in the point F. If any of the lenses have a different focal length from the rest, the coincidence of its focus with that of the other may be easily effected by varying its distance from F. The whole spherical surface, whose section is AMN, except a small opening for admitting the object to be fused, may be covered with lenses, having all their foci coincident at F; though it will, perhaps, be more convenient to have the posterior part MN without lenses, and occupied by a mirror of nearly the same radius FA as the sphere. The object of this mirror is to throw back upon the object at F the light that passes by it, without producing any effect. Each of the lenses, except the lens A, is furnished with a plane glass mirror, which may be either fixed to the general frame of the sphere, or placed upon a separate stand. When this combination is completed, the sphere is exposed to the sun, so that its rays may fall at right angles upon the lens A, which will, of course, concentrate them at F, and produce a pretty intense heat. The plane mirror PQ, when properly adjusted, will reflect the sun's light perpendicularly upon the lens B, by which it will be refracted accurately to the focus F, and produce a degree of heat fully one half of what was produced by the direct refracted rays of the sun through the lens A. A similar effect will be produced by the mirror RS and lens D, the mirror TU and lens C, the mirror VW and lens E, and by all the other mirrors and lenses which are not seen in the section. The effect may be still farther increased by the addition of a large lens at XX. As the angle which the surface of each mirror forms with the axis of its corresponding lens is a constant quantity, the mirrors may be all fixed to the general frame of the sphere, and therefore the only adjustment which the instrument will require, is to keep the axis of the lens A parallel to the direction of the solar rays.

In order to estimate the advantages of this construction, let us compare its effects with those of a solid lens, which exposes the same area of glass to the incident rays.

1. In the burning sphere, almost the only diminution of light is that which arises from reflection by the plane mirrors, and which may be estimated pretty accurately at one half of the incident light; but this loss can be amply compensated by adding a few more lenses.

2. In the solid lens, a great diminution of light arises from the thickness of the central portions, and from the obliquity of the parts at the circumference; which, we conceive, will be fully equal to the light lost by reflection in the burning sphere.

3. In the burning sphere, the lenses may be obtained of much purer glass than can be got for a solid lens; and therefore, *cæteris paribus*, they will transmit more light.

4. Owing to the small size of each lens in the burning sphere, the diminution of effect arising both from spherical aberration and from the aberration of colour, will be very much less than in the solid lens.

5. In the burning sphere, the effect is greatly increased, in consequence of the shortness of the focal length of each lens, and the greater concentration of the incident light.

6. In the burning sphere, all kinds of lenses may be combined. They may be made of any kind of glass, of any diameter, and of any focal length; and the lenses belonging to different individuals may be combined for any occasional experiment, in which a great intensity of heat is requisite.

In the application of the preceding principle to a portable instrument, the different mirrors may be all cemented together, so as to form the frustrum of a pyramid, having as many planes as there are lenses surrounding the central lens. A section of this pyramid is shown in Plate CVI. Fig. 6., and a plan of it in Fig. 7. Each plane glass which composes the pyramidal mirror is so placed as to reflect the incident rays upon the lens B or C which is adjacent to it; while the central lens A converges to the same focus as the rest, the direct light of the sun which traverses the axis of the pyramid. Thus in the plan, Fig. 7., the direct light of the sun falling upon the lens A, is refracted to the focus ϕ, in Fig. 6.; the light which falls upon the mirror B, is reflected perpendicularly upon the lens *b*, which refracts it to the same focus ϕ; the light which falls on the mirror C, is reflected upon the lens *c*, and so on with the rest; so that a whole column of rays, nearly equal in magnitude to the polygonal surface BCDEFG, Fig. 7., is concentrated to one point ϕ. Instead of the glass mirrors, a conical frustrum of tin or of silvered copper might be advantageously employed.

For farther information upon burning instruments, see Wolfii *Opera Mathematica*, tom. ii. p. 165—167. Traberus, *In Nervo Optic.* lib. ii. cap. 12. prop. 5. cor. 1. Vilette, *Journal des Savans*, 1666, p. 125, 1st ed. p. 74, 2d ed. *Ibid*, 1679, p. 284. *Phil. Trans.* No. 6. p. 95. *Do.* No. 33. p. 631. *Do.* No. 40. p. 795. *Do.* 1719. vol. xxx. No. 360. p. 976. Tschirnhausen, *Phil. Trans.* vol. xvi. 1687, No 188, p. 352; and *Act. Erudit.* 1687, Jan. p. 52. Hoesen, *Phil. Trans* 1768, vol. lix. p. 4. La Garouste, *Mem. Acad.* tom. i. p. 276. Buffon, *Supplement a Histoire Naturelle*, tom. ii. 8vo. Par. 1774. *Sixieme Memoire*, p. 181—309. Dutens *Du Miroir Ardent d'Archimede*, Paris, 1755. *A Description of the great Burning Glass made by M. Vilette and his two Sons, born at Lyons, with some Remarks upon the surprising and wonderful Effects thereof*, London, 1719. See also *Mem. Acad.* 1747. Zeiher, *Nov. Com. Petrop.* tom. vii. 1758, 1759, p. 237. Richman, *Nov. Com. Petrop.* vol. iii. p. 340. Nollet, *Mem. Acad. Par.* 1757, p. 896. Kircher's *Ars Magna Lucis et Umbræ*, p. 772. Courtivron, *Mem.*

Acad. Par. 1747, p. 659. Trudaine, *Mem. Acad. Par.* 1774, p. 62. *Journal Encyclopedique*, 15th Sept. 1777. Cadet and Brisson, *Mem. Acad. Par.* 1777, p. 541. Dupuy's *Mem. Acad. Inscript.* 1777. (β)

BURNLEY, a market town in Lancashire, stands on a peninsula, formed by the rivers Colder and Brown, 213 N. of London, and at a small distance from the Leeds and Liverpool Canal. Some considerable manufactories of linen and cotton are established on the adjacent rivers; and the vicinity abounds with excellent pit-coal and quarries of free-stone, flags and slate. It has a handsome chapel of ease, and two dissenting meeting-houses. There are five annual fairs held in Burnley, and a weekly market on Monday. Number of houses 682, inhabitants 3305, of whom 940 are employed in trade and manufactures. (*p*)

BURNS, Robert, a distinguished Scottish poet, was born on the 25th of January 1759, in a small house about two miles from the town of Ayr, and within a few hundred yards from "*Alloway's auld haunted kirk*," which the poet has rendered so famous in his *Tam o' Shanter.* His father was a small farmer and gardener, and overseer to Mr Ferguson of Dunholm. Burns was sent, in his sixth year, to a school at Alloway Mill, about a mile distant; but was soon after placed under a young schoolmaster of the name of Murdoch, whom his father, poor as he was, engaged, in conjunction with some neighbours, to instruct their families, and live at their houses in rotation. This teacher seems to have had an amiable ambition to cultivate the talents of his pupil, though he had little anticipation of his fame: he taught him English grammar, a circumstance of great importance to Burns, in facilitating his correspondence and conversation with persons of superior education at a subsequent period of his life. In 1767, Burn's father quitted the birth place of our poet, and took a farm at Mount Oliphant, a change of residence which made his attendance at Murdoch's school more irregular; and at the end of two years and a half from the commencement of his tuition, Murdoch quitted the place for a different appointment. Burns was thus left with no other instructor than his father, at the farm of Mount Oliphant; but the venerable rustic seems to have done all that lay in himself for the education of his family. He taught them arithmetic by their solitary evening candle, and borrowed for them some useful books, such as Salmon's *Geographical Grammar*, Derham's *Physico and Astrotheology*, and Ray's *Wisdom of God in the Creation.* He was also a subscriber to Stackhouse's *History of the Bible.* Whatever interests us in the Bible, (and there is nothing which interests a young and curious mind so much as elucidations of its history,) is, independant of all influence on morals—a most valuable guide to good taste. In tracing the education of Burns, (an education interesting, because it is scanty,) this early direction of his mind to the sacred writings is a prominent circumstance.

About the age of 13, he was sent for a week at a time, alternately with his brother, to the parish school of Dalrymple, during a summer's quarter, to improve his hand-writing. The following summer, as his faithful friend Murdoch had been appointed to the English school at Ayr, he was boarded with him for three weeks, to revise his English grammar, and to acquire a little French. Wonderful it is, that, during a fortnight's instructions in the latter language, he was enabled to translate it in prose. This seems to have been all his accomplishment in French; yet it is the only instance of his manly and modest nature being betrayed into vanity, that he piqued himself so much upon it, as to affect French phrases, when broad Scotch would have served him better. He even sometimes tried to speak it. On one occasion, when he called in Edinburgh at the house of an accomplished friend, a lady who had been educated in France, he found her conversing with a French lady, to whom he was introduced. The French woman understood English; but Burns must try his powers. His first sentence was intended to compliment the lady on her apparent eloquence in conversation; but by mistaking some idiom, he made the lady understand, that she was too fond of hearing herself speak. The French woman, highly incensed, replied, that there were more instances of vain poets than of talkative women; and Burns was obliged to use his own language in appeasing her.

He made a slight attempt to learn Latin, but did not persevere. Upon the whole, the instructions already mentioned, with a quarter's attendance, at the age of 19, in geometry and surveying, and a few lessons at a country dancing school, form the history of Burns's education. From the books which he read during that period, he had imbibed a smattering of history and philosophy; but till the time of his becoming an author, his brother assures us, that he was imperfectly, or not at all acquainted with our most eminent English authors. We have been thus minute in noticing the history of our poet's mind, because his education has been sometimes as much over-rated as under-rated. It has been said to be equal to that of Shakespeare.* If the education of a poet means that reading which shall best inspire a poet, we beg to say, with deference to the high authority which we contradict, that his reading must have been infinitely inferior to that of Shakespeare. The great ancient poet lived in an age overflowing with chivalrous and romantic books, the richest food for the imagination; in an age, too, when translations were sought with more avidity; translations which Shakespeare must have perused incessantly, from his business of writing for the stage.

But the youth of Burns was depressed by circumstances still more dispiriting than want of education. His father was unfortunate on the farm of Mount Oliphant. The family lived in a state of toil and poverty; for several years, butcher's meat was a stranger in their house, and Robert, who was the eldest, threshed in the barn at 13 years of age, and at 15 was the principal labourer on the farm. To this scanty diet, and exhaustion of strength, aggravated by the prospect of still deeper family distress from the declining health of his father, his brother ascribes the melancholy and nervousness which fixed on his constitution, and eventually drove him to baneful reliefs. "This kind of life (he says,) the cheerless gloom of a hermit, and the unceasing moil of a galley slave, brought me to my 16th year, a little before which period I first committed the sin of *rhyming*." The object of his first attachment was Mary Campbell, a simple Highland girl, his fellow-reaper in the same field. He was separated from this early idol of his attachment by the poverty of circumstances, which did not allow to either of them a choice of residence, or an opportunity of meeting after separation. His heart was not so tenacious of attachment as that of Petrarch, (though his poetry speaks a more sincere language,) and we find him changing its object of idolatry several times before his marriage. But if he was too honest to boast of unvaried fidelity, he was too faithful to his first love to hear of the death of Mary, without the sincerest agitation. He was a married man when he received the news. He entreated his wife Jane to sing to him all the tenderest airs, which she knew had power to solace his spirits in a state of emotion; after which, he withdrew himself, and for several hours gave way to a flood of tears, and the deepest paroxysms of grief. After he was calmed, he wrote his *Address to Mary in Heaven*, a most exquisite effusion.

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* *Edinburgh Review of Burns's Reliques*, edited by Mr Cromek.

His father removed from Mount Oliphant to a neighbouring farm, called Lochlea, and there Burns continued from his 17th to his 24th year. In his 23d year, he attempted to settle himself in business as a flax-dresser in the neighbouring town of Irwin; but his shop took fire one unhappy evening, when he was celebrating the welcome of the new year with a carousal, his stock was consumed, and he was not so fond of the trade as to attempt obtaining credit for a new adventure. His father died soon after, and his all went to his creditors; but the family contrived to collect some money among themselves, and entered on the neighbouring farm of Mossgiel. Robert now said to himself, "Come go too, I will be wise;" he read farming books, calculated crops, and attended markets; but neither this purposed wisdom of the poet, nor the steady sagacity of his brother Gilbert, could avert misfortunes. The soil of their farm was unimprovable, and a succession of bad crops obliged them to abandon it, with great loss of stock, at the end of four years. During this period, Burns had become known in the neighbourhood as a maker of rhymes. A satire on the Calvinistical clergymen of the place had met with applause, not only from the laity, but from a certain description of the clergy, who relished humour. *Holy Willie's Prayer* next made its appearance, and alarmed the kirk-session so much, that they held several meetings to consult on taking vengeance on the author. "Unluckily for me (says the poet,) my wanderings led me on another side, within point blank shot of their heaviest metal." He alludes to the church censure, which he was obliged to undergo for his connexion with Jane Armour, afterwards his wife,—a connexion which could no longer be concealed at the time, when he was forced to quit his farm, and had resolved to push his fortunes on the other side of the Atlantic. For want of money to procure his passage to Jamaica, he had thought of indenting himself as a servant. From this necessity he was extricated, by publishing his *Poems* at Kilmarnock: he reaped from them a temporary supply, but not sufficient for the present to set aside his thoughts of emigration. In the mean time, his pride and affections were wounded almost to distraction, by the consequences of his amour. He loved the partner of his disgrace very tenderly, and, as all the atonement he could offer to her, made a private marriage with her. But his affairs being still in a hopeless state, he could form no other arrangement, than that he should leave her behind him at her father's, a substantial farmer, proposing, whilst he pushed his fortune in Jamaica, that they should trust to better circumstances for their re-union. The parents of Jane were, however, more sensible to the misfortune of her having a husband so far removed, than to the disgrace of her having children without the name of a wife, and persuaded her to renounce the marriage, which was informal. Burns, though he sufficiently proved his honour, by marrying her in his prosperity, consented that she should renounce him in his adversity. But, amidst the distraction and gloom of his prospects, the fame of his poems had made a rapid progress. A letter from Dr Blacklock induced him to repair immediately to Edinburgh, after his chest was on the road to the port from which he was to sail, and after he had composed his farewell song to Caledonia. The reception which he met with in his native capital is well known, as the impression which he made by the interesting powers of his conversation is still remembered by many. He possessed, with all his practical folly and misconduct, a quick and almost intuitive power of reading human character. His manners, when he came to Edinburgh, are thus described by Professor Stewart: "They were then, as they continued ever afterwards, simple, manly, and independent,—strongly impressive of conscious genius and worth, but without any thing that indicated forwardness, arrogance, or vanity. The attentions which he received in Edinburgh were such, as would have turned any head but his own. I cannot say that I perceived any unfavourable effect which they left upon his mind. He retained the same simplicity of manners and appearance, which struck me so forcibly when I first saw him in the country. From his conversation, I should have pronounced him to be fitted to excel in whatever walk of ambition he had chosen to exert his abilities."

Among the first encouragers of Burn's genius was the Earl of Glencairn, an accomplished and highminded nobleman;—if he had lived longer, and if his power had equalled his wishes, Scotland (as his biographer remarks) might have still exulted in the genius, instead of lamenting the early fate of her bard. But unhappily at this period, Edinburgh contained an uncommon proportion of men of considerable talents, but devoted to social excesses. Burns was as much beset, by the importunity of those admirers of his genius to share his society, as impelled by the vehemence of his character to indulge in their orgies. The sudden alteration in his habits of life, operated on him physically as well as morally. The humble fare of an Ayrshire peasant he had exchanged for the luxuries of the Scottish metropolis; and the effects of this change on his constitution could not be inconsiderable. He saw his danger, and at times formed resolutions to guard against it; but he had embarked on the tide of dissipation, and was borne along its stream.

The profits of a new edition enabled him, in the year after his arrival in Edinburgh, (1787,) to make the tour of a considerable extent of Scotland. He visited the tomb of Bruce, and knelt at it with characteristic devotion. Unhappily for his habits, he returned to Edinburgh, and spent there the winter of 1787—8. His visit seems to have been without any serious object, and consumed some portion of his capital, which would have been much better bestowed on stocking a farm, than in renewing his round of dissipation. He probably looked, however, to some permanent provision from the extensive patronage which he nominally enjoyed. A provision, was, indeed, at last made for him; but it was a miserable provision,—the place of an exciseman, an office which condemned him to the haunts of smugglers and the society of publicans. Burns humorously expressed his consolation for the lowness of his corps and comrades, by comparing it to the encouragement which he had heard held out by a recruiting serjeant to some young soldiers: "Gentlemen, you have enlisted in the most blackguard corps in his majesty's service; if there is an honest man among you, he is sure to make his fortune in the regiment."

He now took a farm on the banks of the Nith, built himself a house with his own hands, and settled in conjugal union with his Jane. But here his unhappy distraction between two businesses, and the journies which he was obliged to take in his profession as an exciseman, had so bad an effect on his farming pursuits, that, at the end of three years and a half, he found it convenient, if not necessary, to resign the one. His office in the excise had originally produced about fifty pounds per annum. Having acquitted himself to the satisfaction of the board, he was appointed to a new district in Dumfriesshire, worth about seventy pounds per annum; and he settled in Dumfries in 1791. Hitherto, although addicted to excess in company, Burns had abstained from the habitual use of spirituous liquors; but in Dumfries new temptations presented themselves to "the sin that so easily beset him." His life was embittered also by the political persecution (for it can be called nothing else,) which he suffered for expressing the independent principles of a friend to liberty. Information of some unguarded expressions, which he had used in private conversation, was sent to the board of excise, and he was prevented from being cast out of bread and support, only by the interposition of his steady friend Mr Grahame of Fintry.

In the winter of 1795, his constitution, broken by cares, irregularities, and passions, fell into premature decline. The summer returned, but only to shine on his sickness and his grave. In July his mind wandered into delirium, unless roused by conversation; and in that month a fever, on the fourth day of its continuance, closed his life and sufferings, at 37 years of age.

Burns was, in his person, about five feet ten inches high, of a form that indicated strength as well as agility; his forehead was finely raised, indicating extensive capacity; his eyes were large, dark, full of ardour and intelligence; his character, though marred by imprudence, was never contaminated by duplicity or meanness.

As a poet, without accomplishing any work of extensive or complicated design, he has exhibited all the variety of poetical powers which can enter into the greatest works, the conduct of a plan only excepted. The English reader is alive to the force and feeling of many of his passages; but the Scottish reader perceives also, that he is as much a master of the ludicrous and familiar, as of the strong and pathetic. His humour in delineating Scottish character and manners, unfortunately for his name, depends upon a language which is fast expiring; but as long as it remains intelligible, the gaiety and the unsophisticated charm of his pictures from rustic life, will be deeply felt by his countrymen, and will, in all probability, be studied by glossaries, as Chaucer's able pictures of English life are now studied by the English scholar. As a poet, he is superior in force to Ramsay; his humour is of a richer vein than that of either Ramsay or Ferguson, both of whom, as he himself informs us, he had frequently in his eye, but rather with a view to kindle at their flame than to servile imitation. Ferguson's *Farmer's Ingle*, which may be considered as a Scottish pastoral, was certainly the architype of his *Cotter's Saturday Night*. The picturesque simplicity of the former is not only caught by Burns, but it is elevated by touches of tenderness and sublime devotion unknown to Ferguson. The description of these humble cottagers forming a wider circle round their hearth, and uniting in the worship of God, is a picture, as Dr Currie has observed, the most deeply affecting of any which the rural muse has ever presented. Such poetry (it is well added by the same critic,) is not to be estimated by the degree of pleasure it bestows; it is calculated far beyond any other human means to give permanence to the scenes and characters it so exquisitely describes.

As a song writer, he has adapted the Scottish melodies to such appropriate words, that he seems more like one discovering by inspiration certain thoughts which had lain hid in the tune, than like a writer adapting his own thoughts to the music. Sometimes in his descriptive and epistolary poetry, his mirth is coarse, but he is never vulgar (that we recollect) in his songs; even in the rustic and bacchanalian strains. His love songs are the best. In comparing the different faculties of his mind as a poet, we think his feeling predominated considerably beyond his fancy. This may account for the simplicity of his amatory poetry, in the language of which, fancy is always a dangerous intruder. Setting aside the now forgotten authors of ancient ballads, he has done more for Scottish song, than all the other writers in our northern dialect. Crawfurd, Skinner, Ross, and Ferguson, are names not to be put in the most distant competition with his. Ramsay was, with all his other merits, an indifferent song writer. There are not above half a dozen songs true to the national character and dialect, produced within the last century, which have the exquisite stamp of merit sufficient to rank with his happiest effusions. Those few are indeed very beautiful exceptions: The reader will, perhaps, anticipate that we allude to the "Flowers of the Forest," and "Auld Robin Gray," as the most striking instances. In one species of song he had no predecessor: we mean his war songs of Bruce to his troops, and the song of Death. In these he has risen to a lyric energy to which the pastoral genius of our music does not follow him.

Dr Currie has scarcely left any thing to do in illustrating the merit of his chief poems individually; and we owe no small degree of gratitude to the memory of that good and great man, for so fully executing the trust of a critic and biographer to the poet of Scotland. *Holy Willie's Prayer*, which Dr Currie has omitted, is inferior to nothing which Burns has written in force of humour; and his *Cantata of the Beggars*, which Dr Currie has likewise omitted, is another inimitable picture from low life.

We trust, as Scotchmen, we shall be pardoned for discussing at such length, the merits of a poet so peculiar in genius and circumstances. It is not that we underrate the living or the future generation, when we say, that "we shall not look upon his like again." Our ancient language is expiring, and with Burns, or with Macniel at least, it is probable, that Scottish poetry will also expire; we dwell therefore with fondness on the last voice of our Doric muse. We may find again the same genius spring from a cottage, and sufficiently acquainted with veritable life, to interest us in whatever belongs to simplicity and rustic nature; but we shall not again hear a poet, in that dialect which is at once venerable from ancient associations, and endearing, because it has been the real language of our childhood, and entwined with our earliest recollections. The affected rust of obselete words, will not be a substitute for this natural antiquity. Let them plant the moss of language ever so thickly, poets will only make out of this phraseology an artificial pile of ruins. But Burn's song is, to a Scotchman in a foreign land, the *ranz de vaches* of his country. On the banks of the Ganges, or the Ohio, it recals to him scenes of his playfellows, the images of his brothers and his sisters; it speaks to him also of Bruce and of Wallace in the very language which the heroes themselves spoke.

"He was alive (says Dr Currie,) to every species of emotion. He is one of *the few* poets, who have at once excelled in humour, in tenderness, and in sublimity; a praise unknown to the ancients, and which, in modern times, is only due to Ariosto, to Shakespeare, and perhaps to Voltaire. To compare the writings of the Scottish peasant with the works of these giants in literature, might appear presumptuous, yet it may be asserted, that he has displayed the foot of Hercules." (*n*)

BURNTISLAND, or Bruntisland, a royal borough of Scotland, in the county of Fife, stands upon a kind of peninsula at the bottom of the Bin, a steep hill, on the north bank of the Frith of Forth, nearly opposite to Leith. From its insular situation, this town is airy and healthy, not subject to epidemical diseases, and there are dry and pleasant walks at all times in its vicinity. The town is indifferently built, consisting chiefly of one spacious street; and the church is an old square building with a spire in the centre. Its harbour, however, is one of the best on the coast. The bottom is of a fine clay, and vessels ground very easily; and, during spring tides, the water at the heads of the piers is 22 feet deep. It is capacious, secure, and of considerable depth at high water; and being surrounded with hills in the form of an amphitheatre, is completely sheltered from every wind but the south. On each side of its entrance is a projecting ledge of rocks, called the east and west *bush*, which runs out to the sea for about 130 yards, and breaks the heavy swells from the south west; and the headlands of Clayness and Sand-end defend it from the seas which are brought up the Forth by easterly winds. There is excellent anchorage ground in the outer roadstead, where the largest vessels ride in safety. But notwithstanding the local advantages of this harbour, though nature has done much, and a good deal has been done by art, it is still capable of very considerable improvements. It is always dry at low water, and the spring tides ebb from 20 to 30 yards without the piers. To render it commodious, therefore, for passage boats and other small craft to enter and sail at all times of tide, requires only an extension of the piers, which, according to Mr Rennie, might be easily accomplished, as plenty of materials are to be found in the neighbourhood. "For this purpose," says that gentleman in his report to the trustees, "the two ledges of rocks, namely the east and west bush, afford an excellent opportunity; but owing to their being upwards of 400 feet in length, the expence will be considerable. The distance between these ledges, at their extremity, is about 200 feet, and the soundings between them, at low water spring tides, is from seven to eight feet; and the decrease of depth from thence to the present pier is gradual." Such an improvement would not only be of essential importance to the town itself; but were a correspondent pier to be erected at Newhaven, as was proposed, it would be of the utmost advantage to the county of Fife and the public in general, as it would render a direct communication between the two sides of the Forth at all times practicable.

This town, before the union of the two kingdoms, carried on a considerable trade to England in the exportation of corn and malt; but since that time little business of any kind has been done. Within these fifteen years, however, trade has begun to revive; and a considerable quantity of herrings have been annually cured here for a number of years past; but this business has of late been rather falling off.—There is now established in the town, a vitriol work and a distillery, and the business of ship-building is prosecuted to a considerable extent.

An excellent dry dock has lately been constructed by Mr Farnie, an inhabitant of Burntisland. It is very extensive and commodious, being 215 feet in length, and of a proportional breadth. The gates are 43 feet 4 inches wide, and contain $17\frac{1}{2}$ feet of water, which renders it capable of receiving the largest frigates.

Burntisland was strongly fortified by our French allies in the troubles of 1560; and from its natural strength, and its vicinity to the capital, it was then considered as a post of great importance. During the usurpation it stood out against Oliver Cromwell, until he agreed to repair the streets and harbour, and to build a quay; and in 1715 it was surprised and taken by the rebels. The remains of its walls and intrenchments are still visible; and on the south east side of the port are the ruins of an old castle, which was built by the Duries, and which commanded both the town and harbour.

The peninsula on which the town is situated, and also much of the surrounding elevated country, is composed of rocks belonging to one of the newer coal formations. These rocks are greenstone, sandstone, limestone, bituminous shale, slate-clay, clay iron-stone, coal; and we suspect that the trap tuff, amygdaloid, and basalt, which occur on the Bin, Duncarn hill, Orrock hill, Alexander's craig, &c. are members of the same series or formation. The beds of greenstone are frequently traversed by veins, which are filled with beautiful varieties of common chalcedony, flint, quartz, amethyst, calcareous spar, and brown spar. Agates occur imbedded in the greenstone, also in the amygdaloid; and we have observed serpentine and asbest in the greenstone, a fact which shews that serpentine is not confined to the primitive and transition mountains.

The government of this borough is vested in a council, consisting of 14 guild counsellors, and seven trades counsellors. From the former are chosen a provost and three bailies; but sometimes the provost is elected from the neighbouring nobility and gentry, in which case he is a supernumerary. According to the census taken in 1811, Burntisland contains 192 inhabited houses, and 392 families, in which are 738 males and 877 females, making in all 1615 inhabitants. N. Lat. 56° 8′. W. Long. 3° 5′. (*p*)

BURRAMPOOTER. See India.

BURRO. See Boero.

BURROUGH's MACHINE. See Glass-grinding.

BURSARIA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 165.

BURSERA, a genus of plants of the class Polygamia, and order Diœcia. See Botany, p. 200 and 341.

BURTON-upon-Trent, a borough and market-town in Staffordshire, is situated on the west bank of the river Trent, over which it has an old stone bridge of 37 arches. Though an ancient town, it contains several handsome modern buildings; and its church, which was rebuilt in 1722, is much admired for its neatness and convenience. It has a neat town-hall, erected in 1772, at the sole expense of the Earl of Uxbridge; and at the south end of the town are the ruins of a Benedictine abbey, which was founded in 1004. It has also a free-school, and two almshouses. The principal manufactures of Burton are hats, of which large quantities are furnished for the army and navy, ironmongery, cotton, and light woollen stuffs. But it is chiefly famous for its ale, which is not only in high repute throughout England, but is exported to many parts of the continent. Burton is very conveniently situated for commerce, as the Trent is navigable for boats of considerable burden as high as the town; and it has also communication, by means of canals, with the principal cities of the kingdom. It has four annual fairs, one of which continues for five days, and a weekly market on Thursday. Number of houses, 738. Population, 3679, of whom 1325 are employed in trade and manufactures. N. Lat. 52° 50′, W. Long. 1° 36′. (L)

BURY, a borough and market town in Lancashire, is pleasantly situated on the east side of the river Irwell, about nine miles from Manchester, and 194 from London. It is a large and prosperous town, and principally noted for its manufacture of cotton in all its branches, and for coarse woollen goods, called half-thicks and kerseys. Numerous factories are established on the rivers and brooks in the vicinity; and the conveyance, both of the raw material, and of manufactured goods, is greatly facilitated by the canal from Bury to Manchester. This town owes its wealth and commercial importance, in a great measure, to the laudable exertions of Sir Robert Peele, Bart., who has established extensive manufacturing and calico printing works on the banks of the Irwell, and who has given every encouragement to the invention and improvement of useful machinery. The church of Bury, which was rebuilt in 1780, is rather a handsome structure; besides which, it has a chapel of ease, and Methodist, Presbyterian, and Independent meeting-houses. It has also a free school for boys with two masters, and a charity school for boys and girls. A dreadful accident occurred here in 1787, by the falling of the theatre, when nearly 300 persons were buried in the ruins, many of whom were killed, and others terribly bruised. The population of Bury, by the increase of manufactures in its neighbourhood, was more than tripled in less than 30 years. In 1773, it contained 464 houses, and 2090 inhabitants; while, according to the census of 1801, there were 1341 houses, and 7072 inhabitants, of whom 4545 were returned as employed in trade and manufactures. It has three annual fairs, and a weekly market on Thursday. N. Lat. 53° 56′, W. Long. 2° 26′. See *Beauties of England and Wales*, vol. ix. p. 291. (L.)

BURY St Edmunds, a populous borough in the county of Suffolk, is situated on the river Lark, and is remarkable for the salubrity of its climate, which has gained it the distinguished appellation of the Montpellier of England. It owes its name to an abbey, which was founded here, about the year 903, in honour of St Edmund, king of the East Angles, who was murdered by the Danes in a wood at Hoxne, and whose shrine, in the days of superstition, became a place of great resort and veneration. Of this abbey, which was esteemed one of the largest and richest in the kingdom, one gate only remains, which, however presents a fine specimen of its former grandeur. It is a clean and handsome town, containing 34 streets, which are wide and well paved, and intersect each other at nearly right angles; and, including the suburbs, it extends a mile from east to west, and about two miles from north to south. Its principal buildings are, the churches of St Mary and St James's, which are handsome structures, with spacious and elegant windows, and are deservedly esteemed for their exact and beautiful symmetry. The church of St Margaret is now converted into a shirehall, where the county assizes are held. It has also a spacious guildhall, a beautiful market-cross surrounded with iron railing, an elegant little theatre, a free grammar school, four meeting houses, and an hospital, or work-house, for 30 boys, and as many girls. Its only manufacture is spinning wool, which is used in the fabrication of fine stuffs. The government of the town is vested in a recorder, 12 burgesses, and 24 common council men. One of the burgesses is annually chosen alderman, who holds the office of chief magistrate, and six senior burgesses act as assistant justices.

Bury St Edmund's is said to have been the place where the barons of England, at the instigation of Cardinal Langton, entered into a confederacy to assert their privileges against the oppressions of King John; and it is also famous for several meetings of parliament. It was burnt by Sweyn, king of Denmark, and almost completely destroyed; but the abbey was rebuilt by his son Canute, who restored the town to its former importance. In 1257, a violent plague swept off above a thousand of its inhabitants; and, in 1638, upwards of 600 perished by this dreadful calamity.

This borough sends two members to parliament. It has three annual fairs, and two weekly markets on Wednesday and Saturday. Number of houses, 1397. Population 7655, of whom 4198 are employed in trade and manufactures. N. Lat. 52° 20′, E. Long. 0° 50′. (*p*)

BUSCHING, Anthony Frederick, was born at Stadthagen, in Germany, in 1724. After having been instructed in the Greek, Chaldaic, and Syriac languages, and also in mathematics and astronomy, by M. Hauber, the pastor of a German congregation at Copenhagen, he went, in 1744, to study divinity at Halle. In 1746, he published his first work entitled, *An Introduction to the Epistle of Paul to the Philippians*, which was followed by his exegetical lectures on Isaiah and on the New Testament. Having been employed, in 1748, to superintend the education of the eldest son of the Count Lynar, he accompanied that nobleman to St Petersburgh in 1749, and in the course of this journey he planned the new system of geography, which he afterwards executed with so much ability. The difficulties with which he had to struggle in the composition of this work, induced him to leave his present situation (1752,) and to repair to Copenhagen for the purpose of completing it. In this city he conducted a monthly work on the state of the Arts and Sciences in Denmark; and when he returned to Halle, in 1754, he published his *Vindiciæ Septentrionis*, and announced his design of publishing a work on the constitution of the principal states of Europe. This plan, however, was frustrated, by his accepting, in 1759, of the office of extraordinary professor of philosophy at Gottingen, with a salary of 200 rix-dollars to enable him to complete his geography.

In consequence of the death of Mosheim, Busching offered himself a candidate for the professorship of theology in Gottingen; but his religious opinions were not sufficiently sound, and instead of obtaining the object of his ambition, he was ordered by a rescript, issued in 1757, to abstain from lecturing on disputed points in theology, and from publishing any thing on that subject which had not been approved of by the privy council of Hanover.

In 1759, Busching was appointed public professor of philosophy, and his leisure hours were occupied in the completion of his geographical work. In 1761, he accepted of the office of pastor to a Lutheran congregation at St Petersburgh, where he founded a public school, which had risen to such reputation in 1763, that Catherine II. granted it several privileges. Some disputes, however, respecting this institution, produced a difference between him and his congregation, and occasioned his return to his native country. Busching now chose Altona as the place of his residence; and he continued here, notwithstanding the numerous proposals that were made to induce him to return to Gottingen. In 1766, he was appointed director of a gymnasium at Berlin; and in this capital he spent the remainder of his life, respected by all who knew him, and distinguished by his unwearied industry in literary pursuits. A pulmonary disorder, with which he was for several years afflicted, terminated his useful life, in 1793; and, according to his own directions, he was buried in his garden at midnight, without any ceremony.

The productions of this laborious writer were more than an hundred. His Geography, which was published at different times after the year 1754, was completed in six quarto volumes, and went through no fewer than eight editions during his life. He published also a Magazine for Modern History and Geography, which was completed in 22 quarto parts, between 1767 and 1788. His Weekly account of Maps appeared in detached parts, between the years 1773 and 1787. (*π*)

BUSHEL, a measure of capacity for dry commodities. The standard bushel of this country, when measured in the presence of the House of Commons in 1696, was found to contain 2145.6 cubic inches of water; and this water, when weighed, amounted to 1131 ounces and 14 pennyweights Troy. In 1697, it was determined by act of parliament, that every round bushel, with a plain and even bottom, that was 18½ inches diameter and 8 inches deep, should be regarded as a legal Winchester bushel, which will consequently contain 2150.42 cubic inches.

The bushel, in different parts of England, is of various sizes.

	Gallons.
Abingdon and Andover bushel contains	9
Appleby and Penrith, for pease, rye, and wheat,	16
Appleby and Penrith, for barley, big, malt, mixed malt, and oats,	20
Carlisle bushel,	24
Chester do. for wheat, rye, &c.	32
Chester do. for oats,	40
Dorchester do. for malt and oats,	10
Falmouth do. of stricken coals,	16
Falmouth do. for other articles,	20 and 21
Kingston upon Thames,	8½
Newbury,	9
Wycombe and Reading,	8¾
Stamford,	16

(*w*)

BUSHIRE, or more properly Abuschahr, the principal sea-port of Persia, in the province of Farsistan, is situated on the extremity of a peninsula in the Persian Gulf. The town is of a triangular form, surrounded on two sides by the sea, and fortified towards the land by a wall, with twelve bastions, perforated at the top with holes, through which the defenders may point their musketry. The streets are only from 6 to 8 feet wide, and the houses are mean and low, constructed chiefly of mud, or of a soft sandstone, which is obtained from the ruins of Reshire in the neighbourhood. Those of the principal inhabitants are distinguished by a square turret, of which there are nine in Bushire; and this circumstance gives the city, at a distance, very much the appearance of a burying-ground. Its only public buildings are the mosques, which are extremely mean, and of which there are four of the Shiites, and three of the Sunnites. It has also two *hummums*, and two caravanseras. The house of the English resident stands about two miles from the town, and is the only place deserving the name of a building.

Bushire possesses a very commodious harbour, by which vessels can approach close to the city. Fleets of boats from the neighbouring coast bring coarse linen for turbans, earthen pots, mats, &c. which they exchange for dates. From Bombay, Masulipatam, and Bengal, it draws Guzerat kincobs, chintz, long cloths, muslins, &c. for which the return is generally made in specie; but many of its broad cloths are imported from France by way of Russia; and notwithstanding the expence of land carriage, it buys them cheaper than they can be procured from the East India Company. The favourite colours are scarlet and yellow. Its principal exports are carpets, pearls, and cotton; and its inhabitants fabricate from the cotton bushes in the vicinity of the town, a kind of cloth nearly equal to the China nankeen. It carries on also a considerable trade with Shiraz, by means of caravans.

Bushire owes its origin to the Arabs, who, at an early period, had formed settlements along the eastern coast of the Persian Gulf; and, till within these few years, it continued to be an independent state, governed by its own Sheik. The power of Sheik Nasr, the most celebrated of its princes, extended over the low country, called Dashtistan; besides which, he possessed the isle of Bahrein, and a considerable territory in Kermesis. This prince, though perpetually engaged in war, carried on a very extensive commerce with India and Muscat, which brought him considerable wealth. By this he was enabled to maintain a large standing force, which often withstood the whole power of the Persian monarchs; and, on an emergency, he could collect a numerous army of Arabs from the surrounding tribes; who, upon a well-known signal, willingly flocked to the standard of the hospitable chief. "The Sheik of Bushire," says Mr Morier, "is still remembered, in his general conduct with reverence. Whenever his little domain was threatened by the government of Persia, or by a neighbouring chief, Sheik Nasr flew to arms. According to the traditional accounts of the country, his summons to his followers in these emergencies was equally characteristic and effectual. He mounted two large braziers of Piltau on a camel, and sent it to parade round the country. The rough pace of the animal put the ladles in motion, so that they struck the sides of the vessels at marked intervals, and produced a most sonorous clang. As it traversed the Dashtistan, it collected the mob of every district; every one had tasted the Arab hospitality of the Sheik, and every one remembered the appeal, and crowded round the ancient standard of their chief, till his camel returned to him surrounded by a force sufficient to repel the threatened encroachments." His descendants, however, were unable to maintain the government which he had strengthened and so long upheld. His grandson, Abdullah Resoul, a young man of indolent and dissolute habits, inherited none of those qualities, which commanded the affections and services of his people, but merely filled the office to which he had been born, and held his precarious authority only at the will of Persia. Being unwilling or unable to comply with the demand of the governor of Farsistan for a sum of money, he was deposed in 1808, when Mahomed Nebee Khan, formerly a poor merchant, and afterwards Persian ambassador at Calcutta, procured the succession to the government of Bushire, for 40,000 *tomauns*, equal nearly to as many pounds sterling.

The town of Bushire contains about 400 houses, with nearly an equal number of date-tree huts; and its population is estimated at 10,000. N. Lat. 28° 59′, E. Long. 50° 43′. See Morier's *Journey through Persia, Armenia, and Asia Minor, to Constantinople, in the Years* 1808 *and* 1809, p. 56; Waring's *Tour to Sheeraz*, p. 2, &c. in *Philips's Collection of Voyages*, &c. vol. vi.; and Niebuhr's *Travels*, vol. ii. p. 117. (*p*)

BUSTARD BAY, on the coast of New Holland, was discovered by Captain Cook in 1770, and received its name from a species of bustard which he found there, which was as large as a turkey, and the best bird he had eaten since his departure from England. The country about this place is of a dry and sandy soil, and is much worse than at Botany Bay. The hills, however, are covered with trees, which grow separately without underwood; and on the sides of the bay grows the true mangrove, such as is found in the West Indies. "In the branches of these mangroves," says Captain Cook, "there were many nests of a remarkable kind of ant, that was as green as grass; when the branches were disturbed, they came out in great numbers, and punished the offender by a much sharper bite than ever we had felt from the same kind of animal before. Upon these mangroves, also, we saw small green caterpillars in great numbers; their bodies were thick set with hairs, and they were ranged upon the leaves, side by side, like a file of soldiers, to the number of twenty or thirty together. When we touched them, we found that the hair on their bodies had the quality of a nettle, and gave us a much more acute, though less durable pain." The shoals and sand-banks abound with pelicans, and the sea with fish and oysters of various kinds, both hammer and pearl. Captain Cook supposed, that the inhabitants had neither clothes nor habitations; but that they spent the night among the other commoners of nature in the open air. W. Long. 208° 18′, S. Lat. 24° 4′. (*p*)

BUTCHER, a word of uncertain derivation, signifies a person who slaughters cattle for the table, or for sale. In London there are two sorts of butchers: *carcass-butchers*, who kill meat in large quantities, and sell it out to others, called *retail-butchers*, who are dispered in all out-parts, villages, and towns, near the city.

The company of butchers, although ancient, formed no corporation until the third year of James I., when they were incorporated by the name of masters, wardens, and commonalty of the art and mystery of butchers. Their arms are azure, two axes saltierwise argent, between three boars' heads couped, attired or, a boar's head gules, between two garbes vert.

Several useful laws have been made, at different times, for the purpose of regulating the trade of butchers, and preventing those abuses which they might otherwise be liable to commit.

By the statute 15th Car. II. c. 8. no person exercising the trade of a butcher, shall sell, offer, or expose for sale, any live cattle, on pain of forfeiting double value. By 2d and 3d Edw. VI. c. 15. revived and continued by 22d and 23d Car. II. c. 19. now expired, if any butchers shall conspire not to sell their victuals, but at certain prices, they are liable, for the first offence, to a forfeiture of 10*l.* to the king, or twenty days imprisonment, with bread and water only; for the second offence, 20*l.* or the pillory; and for the third offence, 40*l.* or pillory, with the loss of an ear and infamy. And this offence may be determined by the sessions or leet. By the ordinance for bakers, &c. butchers selling swine's flesh measled, or flesh dead of the murrain, shall, for the first time, be grievously amerced; the second time suffer the pillory; the third time be imprisoned and fined; and the fourth time forswear the town. (*Hawk. Stat.* vol. i. p. 181.) By statute 4th Hen. VII. c. 3. no butcher shall slay any beast within any walled town, Carlisle and Berwick excepted, under a penalty of 12d. for every ox, and 8d. for every cow or other beast. Butchers shall not kill or sell any meat on Sundays, under a penalty of 6*s.* 8*d.* by 3d Car. I. c. 1.

By the statutes 1st Jac. I. c. 22., and 9th Ann. c. 11. regulations are made with regard to the watering, wilfully or negligently gashing of hides, or selling them when gashed, and also to the selling of putrefied or rotten hides; to each of which offences different penalties are annexed. By the former statute also, no butcher shall be a tanner or currier, on pain of 6*s.* 8*d.* a day. See Jacob's *Law Dict.*; and Burn's *Justice of the Peace.* (*z*)

BUTE, an island on the western coast of Scotland, lies in the mouth of the Frith of Clyde, and is separated from the district of Cowal, in Argyleshire, only by a long and narrow channel, about half a mile broad. The origin of its name has never been rightly ascertained; though some ancient authors derive it from *Both*, which, in the Irish language, signifies a cell; and they say that St Brendan, an Irish abbot, erected a cell here in the 6th century. It has indeed been variously written, as *Bote*, *Both*, and *Boot*, and we find it denominated *Botis* by the anonymous geographer of Ravenna. The extent of Bute from north to south is fifteen miles; while its medium breadth is little more than three; and it contains between 23,000 and 24,000 Scotch acres. This island has rather a flat appearance, although there is a gradual ascent from the east and west shore, but no where does the ground rise more than 400 feet above the level of the sea. The coast is rocky, and indented with several deep bays, which renders its line of circumference very irregular. Bute enjoys the most genial climate on the west of Scotland; the intense cold of the mainland in winter, and the oppressive heats of summer, being moderated by its proximity to the ocean; and it has been recommended to persons labouring under complaints requiring a mild climate, as equal in most points to Devonshire, and in some even surpassing it. Snow never falls to any great depth, and seldom remains four days upon the ground. Mists and fogs are unknown in this island, though it is sometimes exposed to heavy storms of wind and rain. Yet even these are not so frequent or severe as in some of the neighbouring districts. The high mountains of Arran, by attracting the clouds which are carried by the south-west wind along the Argyleshire mountains towards Glasgow and Greenock, where they discharge their contents, leave Bute comparatively free. It has been remarked, that the months of March and April are here peculiarly dry; and some have even questioned whether more rain falls in this island than upon the eastern coast of Scotland.

The soil of Bute is in general dry and sandy; but, if properly managed, well suited for every kind of husbandry. Plenty of limestone is to be found in various quarters of the island; the beds of sea shells are apparently inexhaustible; and vast quantities of sea-weed are constantly thrown upon its shores. Agriculture, however, is here still in its infancy, and is conducted much in the same way as it was half a century ago, without any deviation or attempt at improvement. The capitals of the farmers, instead of being laid out in improving their land, have been chiefly employed in the herring fishery, which was here carried on to a considerable extent, and which was preferred to agriculture, as it afforded them a more speedy and lucrative profit. Cultivation has thus been almost completely neglected. The lands have been allowed to run waste for want of cleaning, and have been impoverished by an almost constant rotation of cropping, with little or no manure. A course of unsuccessful years, however, have reduced the number of vessels employed in the herring fishery to less than one third, by which the difficulty of procuring labourers for the purposes of husbandry have been considerably lessened; and a spirit of emulation in agricultural improvements has been lately excited among the tenantry, by the liberal encouragement given by the Marquis of Bute for draining and enclosing the different farms upon his property. By such exertions, it is to be hoped, that this spot, so highly favoured by nature, will soon be rendered equal to the richest and most flourishing districts of the kingdom. Most of the island is now well enclosed, and subdivided with ditches and hedges of white thorns, which are tall, thick, and vigorous. They afford shelter and warmth to the land, and make a very agreeable appearance. The roads of this island are ill-conducted, narrow, and in wretched order; and the barbarous customs of thirlage, kane-fowls, and other services, still exist here, but which ought to be universally exploded as the last remains of feudal oppression.

The chief produce of the island consists of barley, oats, and potatoes; also turnips, and artificial grasses, which flourish here uncommonly well. They have a ready market at Greenock and Glasgow for cattle and grain of every kind; and packets are continually passing between these places and Rothsay. Excellent banks for white fishing are to be found all round the island, which are completely neglected for the sake of the herrings; and though there are also abundance of lobsters, crabs, and oysters, yet it is seldom they are to be procured. Bute is well stocked with hares, partridges, snipes, green and grey plovers. It has likewise plenty of ducks, teal, and other sea-fowl common to the western coast of Scotland; and in some winters a great abundance of woodcocks.

The property of this island belongs entirely to the Marquis of Bute, with the exception of the estate of Kaims, and three or four small properties worth from 150*l.* to 200*l.* a-year each. Mount-Stuart, his lordship's country-seat, is an elegant mansion, surrounded with a forest of fine trees, and commanding a beautiful view of the Frith of Clyde, and the shipping which enters that river. The Marquis is admiral of the county, by commission from his majesty; and his power is entirely independent of the lord high admiral of Scotland.

At Langal-chorid are the remains of a Druidical circle; and at Kingarth, the ruins of a church, of which two cemeteries only remain, and near it a circular enclosure called the Devil's cauldron. This building covers an area of thirty feet in diameter, and the walls, which are about ten feet in thickness, and seven feet high, are formed of stones piled together without mortar, but trimmed in the inside in a smooth and regular manner.

Considerable hopes were once entertained, that a seam of coal might be found in this island, and several attempts were made for that purpose, but unfortunately without success. This want of proper fuel is one of the greatest inconveniences under which the inhabitants presently labour, as all their coals must be brought from Glasgow, and at a great expence.

The whole of the north part of this island is composed of primitive and transition rocks, which, in some places, as at Kaims Castle, the seat of Lord Bannantyne, rise into hills of considerable height. The rocks are mica slate, clay slate, and chlorite slate. These strata are traversed by numerous veins of quartz, and also of trap, which are from a few inches to several feet in breadth. Near to Kaims Castle there are several slate quarries; but the slate is inferior to that of Eisdale. The north side of Rothsay bay is composed of slate; so also is the north side of Scalpa bay, which is situated upon the west side of the island, and nearly in a line with Rothsay; but the south sides of these bays are composed of the first flætz, or red sandstone. The country between Rothsay and Cel-Chattan bay, which is the lowest, most beautiful, and best cultivated part of the island, is composed of red sandstone, belonging to the first flætz formation, which is traversed by many veins of trap. From Cel-Chattan bay to the southern extremity of the island, called Gurroch-head, the country becomes nearly as high as in the north end, rising into irregular hills, with abrupt perpendicular crags, as is the case in all countries containing considerable portions of trap rocks. This part of the country is composed of sandstone, and various rocks of the trap formation, and these are traversed by numerous trap veins. We may add, that as thick beds of coal have been found in red sandstone in various countries, this useful mineral may also occur in Bute.

The population of this island in 1801, amounted to 6106. It is now between 7000 and 8000, of whom about 4000 inhabit the royal burgh of Rothsay. Most of the natives speak English very well, but when conversing with one another, they prefer the Gaelic, which is their mother tongue, and which chiefly prevails among the old people.

Bute gives name to a shire, which consists of the islands of Bute and Arran, together with the small isles of Greater and Lesser Cumbray, and Inchmarnoch; and sends a member to parliament alternately with Caithness. The whole shire, according to a very recent and accurate measurement, contains 153.98 English square miles, or 98,547 English acres, or 78,131 Scotch acres. See *Beauties of Scotland*, vol. v. p. 536; Pennant's *Tour in Scotland*, vol. ii.; Sinclair's *Statistical Account of Scotland*, vol. i. p. 310; and *The Farmer's Magazine* for 1811, p. 427. (*p*)

BUTEA, a genus of plants of the class Diadelphia, and order Decandria. See Botany, p. 274.

BUTLER, Samuel, author of the most celebrated burlesque poem in our language, was the son of a farmer at Strensham in Worcestershire, where he was born, according to Dr Nash, in 1612. He received a grammar-school education at Worcester. Wood and other biographers have placed him for seven years at Cambridge; but it is remarkable, as Dr Johnson observes, that Wood, although he pretends to have had the account from his brother, could not tell his hall or college; and it is not likely that Butler should have so long inhabited a place of learning, with so little distinction as to leave his place of residence uncertain. The learning of Hudibras may be objected to Dr Johnson's doubts of his academical education, yet it must be said, that the learning which shews itself in allusion may be collected from various reading; while that which illuminates dissertation, can perhaps be imbibed only in seminaries of erudition. On his return to his own county, he was for some time clerk to Mr Jeffreys of Earls Croomb, an eminent justice of the peace. In his service he had leisure not only for study, but recreation. He addicted himself to music and painting. In the latter he was instructed by Cooper, whose friendship for him is recorded, to the mutual honour of the poet and painter. He lived afterwards in the family of the Countess of Kent, probably as assistant to the celebrated Selden, who was the steward of the Countess. Here he enjoyed the use of a good library, and the still greater advantage of Selden's acquaintance. This circumstance may explain his learning, without having recourse to a college. His next residence was with Sir Samuel Luke, at Cople in Bedfordshire, an officer of Cromwell, and a leader of the Puritans, whose character furnished him with the original of Hudibras. At the Restoration, Butler is described as an expectant for the reward of loyal principles; he was, however, only made secretary to the Earl of Carbury, president of the principality of Wales, who conferred on him the stewardship of Ludlow Castle, when the court of the marches was revived. In this part of his life he married Mrs Herbert, a gentlewoman of fortune; but her fortune was lost by bad securities. In 1663 was published the first part of his *Hudibras*, which, being recommended by the taste of the Earl of Dorset, was quoted by the king, and studied by the courtiers. In 1664, the second part appeared. Yet with all his literary merits and party claims, praise was his only reward. He was introduced, we are told by Packe, to the Duke of Buckingham; but his Grace had no sooner set himself down beside the poet and his friend Wycherley, who introduced him, than observing a couple of ladies pass by an open door, he quitted his engagement to follow another kind of business. This anecdote seems to be corroborated by some verses against Buckingham, written with extreme acrimony, and which have been published by Mr Thyer in the genuine remains of Butler. Notwithstanding this discouragement and neglect, he still prosecuted his design; and in 1678 published a third part of *Hudibras*, which still leaves the poem imperfect and abrupt. He died in 1680, and Mr Longueville, who had supported the poet in his indigence, and who received from him his manuscripts before his death, having in vain solicited a subscription for his interment in Westminster Abbey, buried him at his own cost in the church-yard of Covent-garden. Sixty years after his death, Barber, a printer, erected a monument to him in Westminster Abbey, which, by a strong allusion to his poverty,[*] has probably created a common tradition that he died of absolute want.

It will not be necessary to inform many readers, that the object of the poem of *Hudibras* was to expose the fanaticism of the Puritans, in the same manner as Cervantes exposed the passion for knight-errantry. Hudibras is the Don Quixote, and Ralpho is the Sancho of Butler. Both satirists exposed the folly of their respective objects of ridicule when they had fallen into decline; but it must be owned, that the Spanish satirist is as superior in generosity to his fallen foe, as he is in originality: Cervantes makes us love Quixote while we laugh at him; Butler clothes him in deformity and contempt. The Spanish mock hero is much more natural and probable; he springs out of circumstances easily and instantly conceivable;—the Puritan mock hero arises from an odd complexion of the times; he is the creature of politics, of peculiar and local manners, and superstition; a compound of pedantry, fanaticism, and knight-errantry. We can imagine at once a Don Quixote, because he is a simple though mock knight-errant, translated as he is from a foreign language; but we cannot imagine a real Hudibras, though we read of him in English. The reason seems principally to be, that we have united in Hudibras the incongruous characters of Puritan and knight-errant. What was chiefly ridiculous in the former of these characters was false humility, in the latter false elevation. It is impossible to satirize both under the same hero. Butler makes his hero low at the outset, and it is impossible to debase him by incident; he fails, therefore, in effecting any contrast of character between his knight and the squire, his obstinate independent clerk;—unlike the happy model of Cervantes, where our chief entertainment arises from the contrast of the noble master and the cunning servant. Independent of this infelicity, the story of Hudibras is meagre and uninteresting; it wants unity; and though we cannot pronounce what the story would have been had it been prolonged, it is easy to perceive, that out of such a design no captivating fable could ever have been formed. The dialogue of Cervantes is for ever amusing: that of Butler is fatiguing, not from insipidity, but from straining the mind to attend to subtle, remote, learned, or metaphysical combinations.

Yet while we may safely pronounce the poem of Hudibras to be inferior to no human production in point of wit, we must forget our own sensations in reading it, or we must pervert the meaning of the word humour, if we deny it that quality. Whatever may be said of the other characters, that of the lawyer, at least, is supported with exhilarating humour. The principal merit of the poem is its close sententious wit;—its profoundly wise, and true, and surprising, though laughable adages;—its successful travestie of every metaphor and simile in the store-house of poetry;—its converting rhyme itself from an ornament to an instrument of burlesque in versification; and the talent which it displays of sending at once the powers of fancy and erudition in quest of ludicrous associations. Hudibras is a mine of mottoes. He had watched (as Dr Johnson observed) with great diligence the operations of human nature, and traced the effects of opinion, humour, interest, and passion. From such remarks proceeded that great number of sententious distichs which have passed into conversation, and are added as proverbial axioms to the general stock of practical knowledge. (*z*)

BUTLER, Joseph, a prelate of the greatest distinction in the church of England, was a native of Wantage in Berkshire. His life, like that of most literary characters, affords but few events remarkable either for their singularity or their variety. But on this, as on many other occasions, we have to lament the conduct of surviving friends, who, with a view to conceal all the more human features of a great man's character, deprive us of all access to his familiar society, and exhibit him only at a distance in the cold and dignified attitude of a statue. Whether we consider the high elevation, from a low origin, to which he attained in life, the rank, dignity, and learning of his friends, or the mighty and almost unparalleled grasp of his own intellectual powers, Bishop Butler was surely a man, whose opinions, sayings, and private habits of life, not excepting even his juvenile history, could bear as minute a recital, as those of any literary character of his or any other time. He was born in 1692, of respectable parents, of the Presbyterian denomination; who perceiving, at an early period, the predilection of their son for a life of study, did not fail to encourage, to the utmost of their power, so flattering a disposition. By his respectable industry as a shopkeeper, his father, Mr Thomas Butler, was fortunately enabled to afford Joseph, who was the youngest of eight children, a course of preparatory education at the grammar school of Wantage, under the Rev. Philip Barton; whence, with the view of qualifying him for the ministry, he naturally sent his son to an academy of his own persuasion. This Presbyterian seminary, which had the honour of giving Butler and some other great men to the world, was superintended by Mr Jones, first at Gloucester and afterwards at Tewkesbury.

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[*] *Ne cui vivo deerant omnia, deesset etiam mortuo tumulus.*

Here our young student soon rendered himself conspicuous, by his intense application to his professional studies, and particularly to the department of metaphysics. Of this early distinction, a memorable proof will always remain. Dr Clarke's celebrated demonstration of the being and attributes of God, was at this time in the hands of the learned, and of course commanded the deep attention of the kindred mind of young Butler. Though scarcely 20 years of age, and still immersed in the multifarious routine of academical pursuits, he contrived to make himself master of that most abstruse demonstration; studying, however, not so much the book as the subject, rigidly examining the validity and consistency of the arguments, and even rejecting some as either obscure or inconclusive. These juvenile doubts he respectfully transmitted to Dr Clarke in an anonymous letter, dated the 4th November 1713. His candour, sagacity, and depth of thought, did not fail to excite the particular notice of the Doctor, who, no doubt, conceived the letter to be the production of some experienced philosopher. Encouraged by this attention, he addressed the Doctor several times upon the same subject, and was likewise honoured with his great antagonist's replies: and the whole correspondence being soon after annexed to the admirable treatise above mentioned, it has been retained in all the subsequent editions. The only person in Butler's secret, on this occasion, was his friend and fellow pupil Mr Secker, who conducted this philosophical affair with all due mystery, by carrying the letters in person to the post office at Gloucester, and bringing back Dr Clarke's answers.

It is natural to suppose, that the acquisition of such a promising mind would soon become an object of desire with the leaders of any church; and the particular friendship of Dr Clarke, with which, on the disclosure of his name, Butler was immediately honoured, could not fail to inspire his youthful mind with the desire of signalising his talents in a more extensive, and therefore a more useful field, than that afforded by a dissenting communion. Accordingly we find that about this time the subject of non-conformity engaged his particular attention; and the result of his deliberation was a determined resolution to attach himself to the church of England. Against this measure his father protested, with a warmth natural to a man concerned for the principles of his son, and interested in the honour of his party; and to strengthen his remonstrances, called in a meeting of the most eminent Presbyterian divines. All their united endeavours to dissuade him from his purpose were in vain: his resolution was fixed; and he was soon afterwards suffered to remove to Oxford, where he was admitted a commoner of Oriel college, on the 17th of March 1714.

It does not appear at what precise time Butler took orders, nor by what bishop he was ordained. One thing seems highly probable, that some deviation from the established rules was tacitly permitted in his case, in consideration of his previous acquirements; for it is reported that very soon after his admission at Oxford, he entered into the church, and occasionally assisted Mr Edward Talbot in the divine service, at his living of Hendred near Wantage.

His acquaintance with this gentleman, who was the second son of Dr William Talbot, successively bishop of Oxford, Salisbury and Durham, commenced at the university: it soon ripened into intimate friendship, and, together with the active co-operation of Dr Clarke, laid the foundation of all Butler's subsequent preferment. At the recommendation of Mr Talbot and Dr Clarke, he was appointed by Sir Joseph Jekyll, at the age of 26, and four years after his admission at Oxford, to the very honourable and conspicuous situation of preacher at the Rolls-chapel. Here he continued three years before he took any degree at the university; for he went out bachelor of law on the 10th June 1721, this being the earliest period at which that honour could suitably be conferred on him.

Mr Butler held the situation of preacher at the Rolls till 1726; in the beginning of which year he gave to the world, in one volume octavo, Fifteen Sermons preached at that chapel; a work which deservedly raised him to the highest consideration as an acute and solid reasoner. Though these discourses are, for the most part, rather scientific disquisitions on morals, than what is generally understood by sermons, and, therefore, exclusively adapted to the closet; their value, to men of reflection, is not the less on that account. They proceed on a systematic theory of morals, partly borrowed from the ancient philosophers, and partly invented by himself. This theory consists neither in the welfare of society, nor the fitness of things, nor the will of God, as generally understood; but according to the expression of the ancient schools, in following nature; that is, in acting in conformity to those views with which nature has furnished us with particular powers and faculties. Butler has employed, and with great success, a constant appeal to facts, and the inductive process of reasoning, to the subjects of morals and religion; and in both, has availed himself of the analogy of nature. Of the abstruseness of these discourses, the author himself was so sensible as to offer an apology, in a preface to the second edition, revised and improved in 1729; presenting at the same time an abridged statement of the principles laid down in the sermons. It is much to be lamented, that Butler, like some other great men of powerful intellect, should seem to have undervalued the graces of composition. In the style of these sermons, and indeed of all the writings of this celebrated divine, while we admire his profound research, and original train of reasoning; a certain embarrassment of language impedes our progress, and to the natural abstruseness of the discussion, adds the fatiguing exercise of frequently retracing our steps to ascertain the scope and direction of the argument. This defect was not unobserved by his friend Secker, who is said to have kindly done all in his power to give more perspicuity and ease to all the compositions of Butler. But notwithstanding all these blemishes, which are perhaps somewhat aggravated at present by the hand of time, the sermons are master pieces in their kind, and must for ever continue to command the attention of the divine and the philosopher.

Whilst Butler was thus occupied at the Rolls, his friends were not inattentive to his preferment; for having been recommended by Mr Talbot, on his death-bed, to his father the bishop of Durham, he was presented to the benefice of Haughton in 1722; nearly four years before the publication of his sermons. This living and the Rolls he held together for three years, agreeably dividing his time between the town and the country: a mode of life peculiarly adapted to the temperament of a man who was at once dependent on the society of his friends, and yet attached to contemplation and retirement. In 1725, his steady friend Secker, who had acquired a very considerable influence with Bishop Talbot, prevailed on that prelate to remove Butler from Haughton, where extensive repairs of buildings had become necessary, for which the incumbent had neither money nor talents. He was accordingly presented to the rectory of Stanhope in the same diocese: a living of much superior value, and indeed one of the richest parsonages in England. Having quitted the Rolls in the following year, he resided wholly at Stanhope; where, for the space of seven years, he devoted himself to the conscientious discharge of all the duties of a parish priest.

This retirement, however favourable to Butler's contemplative turn of mind, and to the production of his *Analogy*, which we may suppose was now the main employment of his recluse hours, was far too solitary for his disposition, which had in it a deep tincture of melancholy. He felt at times, most painfully, the want of that select society to which he had been accustomed in the metropolis, and which was so well calculated to afford a delightful relaxation after the fatigues of study, and of professional labour. This circumstance was not unknown to his friends, who were therefore extremely anxious to bring him back into the world. Mr Secker particularly exerted himself on this occasion. Having himself been appointed king's chaplain in 1732, he one day, in the course of a conversation with Queen Caroline, took occasion to mention his friend's name. Her majesty said she thought he had been dead: and asked Archbishop Blackburne if this was not the case. His reply was, "No, madam, but he is buried." This activity of Mr Secker in behalf of Butler, was at last rewarded with complete success; having found means, on the elevation of Mr Charles Talbot to be lord chancellor, to have him effectually recommended to his lordship for his chaplain. The chancellor accordingly, in 1733, nominated Butler, who accepted the nomination, and immediately set off for London. Taking Oxford in his way, he was there created Doctor of Laws. A prebend in the church of Rochester was also conferred upon him by the same patron; and that he might once more return to his favourite mode of life, it was agreed that he should still reside half the year at Stanhope.

In 1736 he was appointed clerk of the closet to the queen; to whom, in the same year, he presented a copy of his great and immortal work, "The Analogy of Religion, Natural and Revealed, to the constitution and course of Nature;" together with two brief dissertations annexed to it; one on personal identity, and the other on the nature of virtue.

His philosophy of morals had been published by the author when young, in the form of sermons. His riper judgment induced him to throw his theory of religion into the form of regular dissertation. The reasoning contained in the Analogy, is founded on a topic, which the author had treated in one of his sermons, the ignorance of man; a topic to which he was somewhat partial on all occasions. The general idea which runs through the work is as follows:—The difficulties which occur in religion, both natural and revealed, are precisely of the same complexion as those which occur in the economy of nature. But as, from our limited knowledge, the difficulties of nature are admitted to be no proof of its not having a divine author; so the difficulties in religion, having probably no other cause than our ignorance, not merely are no evidence against its truth; but afford rather a presumption, from the similarity in both cases, that both nature and religion are conducted by the same government, and on the same plan. Since, then, we perceive a striking resemblance between the systems of nature and of religion, and as to many remarkable events in the economy of grace there may be found corresponding facts in real life; it is logical to conclude, that this resemblance will be found to hold in parts beyond our view, and that to natural occurrences which take place at present, there will be corresponding occurrences in an after state.—Taking therefore this analogy as his guide, Butler follows it most beautifully through the constituent tenets of religion, and thus confirms the doctrines of a future existence, of probation, of retribution, of the moral government of God, and of the peculiar doctrines of revelation. It ought ever to be had in recollection, that from its very nature, analogical reasoning is, by itself, incapable of establishing any point, except perhaps, the single one of theoretical possibility. Its chief effect is merely to confirm evidence derived from a different source; and while it pretends to no infallible deductions, contents itself with simple probability. There are two important objects which Dr Butler has accomplished by his Analogy, with respect to the Christian religion: he has at once disposed our minds more readily to admit its positive evidences, by shewing its conformity to the other departments of the divine government; and clearly demonstrated that it is not, *primâ facie*, according to the absurd assertion of some Deists, a proper subject of ridicule, but a system that at least *may* be true.

During the short remainder of Queen Caroline's life, who died in 1737, she required the attendance of Dr Butler for two hours every day, from seven to nine in the evening. Her demise was no obstacle to his preferment; for so effectually had that excellent princess recommended him to his majesty's protection, that in the ensuing year he was promoted to the episcopal dignity, being consecrated to the see of Bristol on the 3d of December, 1738. In addition to this splendid mark of royal approbation, the king conferred upon him, in 1740, the deanery of St Paul's, London; upon which, from the great accumulation of duty, he immediately resigned the rich benefice of Stanhope. During this period he was called upon to preach several sermons on public occasions in the metropolis; which were printed, and have been since annexed to those preached at the Rolls. In

1746, upon the death of Dr Egerton, bishop of Hereford, Dr Butler was made clerk of the closet to the king; and on the 16th of October, 1750, he was translated to the princely see of Durham,—an appointment which we may easily conceive was peculiarly agreeable to the worthy prelate, from having been so long connected with that diocese in his younger days.

At his primary visitation, which was in 1751, he delivered the famous charge to his clergy, which was printed at Durham. Of this his first and indeed last charge, the principal object was "external religion." For, having long observed the growing indifference of the people, and particularly of the lower orders, to sacred matters, he, on this occasion, strenuously insisted on the usefulness of outward forms and institutions, and of calling in the aid of the senses to excite feelings of duty and devotion. The forms of religion he would have to occur as frequently as possible, so as ultimately to produce some general effect; and this he shewed to have been the policy under all the other systems of religion. Under these, he observes, religion "has had a conspicuous part in all public appearances, and the face of it has been kept up with great reverence throughout all ranks, from the highest to the lowest, not only upon occasional solemnities, but also in the daily course of behaviour. In the heathen world, their superstition was the chief subject of statuary, sculpture, painting, and poetry. It mixed itself with business, civil forms, diversions, domestic entertainments, and every part of common life. The Mahometans are obliged to short devotions five times between morning and evening. In Roman Catholic countries, people cannot pass a day without having religion recalled to their thoughts, by some or other memorial of it; by some ceremony or public religious form occurring in their way; besides their frequent holidays, the short prayers they are daily called to, and the occasional devotions enjoined by confessors. By these means, their superstition sinks deep into the minds of the people, and their religion also into the minds of such of them as are serious and well disposed." It is evident, from the general strain of the good bishop's charge, that he highly approved of this policy, and that he even regretted that partial diminution of pomp and splendour which the Reformation had introduced into the service of the English church. "Indeed," says he, "in most ages of the church, the care of reasonable men has been, as there has been for the most part occasion, to draw the people off from laying too great weight upon external things; upon formal acts of piety. But the state of matters is quite changed now with us. These things are neglected to a degree, which is, and cannot but be, attended with a decay of all that is good. It is highly seasonable now, to instruct the people in the importance of external religion."

We are fully aware of the reverence due to such a character as Bishop Butler; but we cannot help regretting, that he should seem to have recommended so emphatically those mechanical expedients for exciting devotion, which in all ages have degenerated into superstition. It is singular enough, that, among all these outward means, he does not once allude to education. The bishop asks, whether it would be superstition, were men brought to be affected with devout feelings at the sight of a church? We conceive their feelings would be much more rationally excited, were the English poor more generally taught to read the Bible: and all the excellent methods of external religion recommended in the charge would certainly be multiplied in their effects, by the single addition of a competent education.

We can easily conceive, that the bishop would have gone much farther in reviving external pomp, did the constitution of his church admit of it. And this conclusion we are warranted to draw, not merely from the general strain of the charge, which some how or other has narrowly escaped being suppressed; but from another circumstance still more unequivocal: we allude to the marble cross which he erected in his chapel at Bristol, to enliven his own private devotions. This bold attempt at reviving ancient forms, calculated to impose on the senses, gave great and universal offence to the church; and, combined with the theory inculcated in the charge, gave rise to public discussions, which, though anonymous, were yet sufficiently important to command attention. In 1752, there appeared an able and spirited pamphlet, understood to be written by a clergyman of the church of England, entitled, *A serious Enquiry into the Use and Importance of external Religion*, addressed to the bishop. The writer, the only direct antagonist that Dr Butler ever met with, accused him, in a pretty sharp style, of speaking favourably of pagan and popish ceremonies, and countenancing, in some degree, the cause of superstition: he animadverts on his number, variety, and frequency of forms, as being too apt to be considered by the vulgar as commutations for their vices, and as something substituted in lieu of repentance; and insinuates, not obscurely, that his lordship was no enemy to the Roman Catholic form of worship. We have been the more particular in our account of the Charge, as we wished to lead the reader to the true foundation of the report which was afterwards raised, that Bishop Butler had actually died in the Roman Catholic communion. This was formally asserted, fifteen years after his death, in an anonymous pamphlet, entitled, *The Root of Protestant Errors examined;* which has been answered by Archbishop Secker, and others. But, in truth, there was not the least reason for such an aspersion. The plain statement has already been given. The bishop, in conformity to his theory, wished to introduce a more ceremonious form of worship, and probably would have had no aversion to pictures and statues, any more than to crosses in churches; but all this has evidently no more to do with the Roman Catholic *faith*, than it has with Presbyterianism. If he took delight in perusing the legends and miraculous lives of Roman Catholic saints, this was no more than has been often done by many other Protestants: besides, as Secker justly observes, Dr Butler was a man who knew how to draw instruction from any book.

By his promotion to the see of Durham, he was placed in a situation highly favourable to the exercise of that beneficence and liberality which constituted one of his greatest enjoyments. Blessed, too, with ample means of encouraging and promoting men of piety and fidelity, and thus promoting practically that religion of which he was one of the ablest defenders, his prospect of doing much good was almost as extensive as his wishes. But this prospect soon vanished. His health began visibly to decline soon after his removal to his new bishopric. When complimented on his great resignation during his indisposition, he is reported to have expressed his regret, that he should be called away so soon from this world, after he had become capable of doing more good in it. During this his last illness he was carried to Bristol, to make trial of the waters of that place: but no benefit resulting from these, he removed to Bath; where, being completely exhausted, he calmly breathed his last, at the age of sixty, on the 16th of June 1752. His corpse was conveyed to Bristol, and interred in the cathedral. A flat marble stone, placed over the spot where his remains are deposited, contains a Latin epitaph, now nearly obliterated, said to have been written by his own chaplain, the learned Dr Nath. Forster.

Few characters are, upon the whole, more entitled to our veneration than Bishop Butler. His works will continue to bear testimony to his strength of mind, and originality of view, as long as their subjects shall interest the world; and he may be ranked among the ablest defenders of revelation, since the age of the apostles. The selection of his topics was sometimes unavoidably influenced by the questions of the day. Some of them are such as, perhaps, would not now be discussed with much interest; but, if they have ceased to agitate the philosophical world, it is in a great measure owing to the rigid accuracy with which they were finally elucidated by himself. It has indeed been remarked, that his reasoning is generally better calculated to silence than to convince; and that, by dwelling so much on the uncertainty and imperfections of the inferences of reason, he is apt to produce a sceptical turn of mind. This, however, was but the manner of the times. The infidels of those days did not all pretend to reject revelation as a subject of rational enquiry. They attacked particular points with all the subtlety of metaphysical argumentation; and hence a necessity was imposed on the friends of religion, to dispute every inch of ground with corresponding minuteness.

Dr Butler's greatest praise is not that of an admirable writer; he was equally distinguished as a man and a Christian. His private benefactions were numerous, and his example in promoting charitable institutions eminently conspicuous. His piety was truly sincere and fervent, leaning, perhaps, a little to the gloomy and ascetic: a character which it possibly derived, in part, from his early education, and partly from a natural disposition inclined to melancholy. His munificence was in all respects equal to the great means with which Providence had blessed him. Whilst bishop of Bristol, he expended, in repairing and improving the episcopal palace, 4000*l.*; being more than the whole emoluments of that see amounted to during his incumbency. At Durham, he supported the episcopal dignity with equal grandeur. He set apart three days in the week for doing the honours of the bishopric, and entertained the principal gentry of the county in the most princely style. To his table were invited even the poorest of his clergy; whom he occasionally visited at their parishes, and treated with the utmost kindness and condescension. Bishop Butler was never married. At his death, it is said that he ordered all his manuscripts to be burnt, without inspection. See *Biog. Brit.*; and Halifax's Preface and Notes to the *Analogy*. (E)

BUTOMUS, a genus of plants of the class Enneandria, and order Hexagynia. See BOTANY, p. 201.

BUTTER, a fat unctuous substance, usually prepared from the cream of cows milk by agitation. It is of a yellow colour, sometimes higher, sometimes lighter, possesses the properties of an oil, and readily mixes with other oily bodies. The process by which it is obtained from cream, is that sort of agitation called churning, well known to every body. When pure, it is soft and concrete, and of an agreeable sweet taste. It melts at the temperature of 96°, and becomes transparent; but if it be kept for some time in this state, a portion of curd and water, or whey, is disengaged, and it assumes exactly the appearance of oil. It has now, however, lost almost all its peculiar flavour.

Butter has been usually thought to be a matter naturally distributed through the milk, and existing, along with the caseous and serous parts thereof, in a state of mechanical suspension, similar to that in which oil is, when suspended in water by means of syrup or mucilage. But though a mixture of this sort, commonly called an emulsion, puts on a white colour like milk, and its oily parts by rest rise to the top, and form a cream similar to the cream of milk, yet the experiments of Messrs. Deyeux and Parmentier seem to have proved, that butter does not actually *exist* in the cream, but that it is formed from it during the process of churning, by certain chemical changes which then occur. These gentlemen were led to form this opinion, by observing, that butter could not be produced in any other way than by agitation; because whatever substances or means they employed to detach either the cheesy or buttery part of the cream, they always found agitation or churning necessary.

Fourcroy considers the *butyraceous matter* of milk as quite distinct from butter; and says, it is a white liquid oil, suspended in the serum, by means of the mucosaccharine and cheesy parts, which, combining with oxygen, forms butter. The oxygen he conceives it to obtain partly from the atmosphere, and partly from the milk itself. He is of opinion, that butter in a small quantity can be obtained without agitation; and says, that the oily particles of the butyraceous matter, which, from their greater levity, float, when the milk is allowed to rest, on the surface of the caseous and serous fluid, absorb oxygen from the atmosphere, and become real butter.

That important chemical changes take place during the operation of churning, there can be no doubt; but the nature of these is still, we apprehend, imperfectly understood. Farther experiments seem necessary to elucidate the subject. In all cases, there is a considerable extrication of gas; and Dr Young affirms, that there is likewise a rise of temperature equal to four degrees. In the Mid-Lothian agricultural report for 1795, it is stated, that cream churned in contact with atmospheric air, absorbed a considerable quantity of it. But Dr Young has shewn, that butter may be obtained from cream by churning, without the contact of air. These two statements, however, are not irreconcileable, since, according to Fourcroy, the butyraceous matter takes its oxygen partly from the air, and partly from the milk. That this matter should absorb oxygen, and thereby acquire the consistence of butter, is quite analogous to what happens to other oily bodies, which all become thicker by absorbing the oxygenous principle. The gas disengaged is probably the carbonic acid gas; for every person must have observed, that when even sour cream is churned, the butter obtained is perfectly sweet, and the milk remaining in the churn, called the butter-milk, is always much less sour than the cream had been.

Though butter is obtained usually by agitating cream, it may be also got by agitating milk as drawn from the cow, and even in greater quantity than from the cream alone of the same milk: a fact well known to those who superintend dairies. Even whey, by churning, yields butter. In the agricultural report before quoted, it is stated, that 27 Scotch pints of whey, that is, about 108 English, afford at an average one pound of butter. The oily part of the milk appears to have so strong an attraction for the other ingredients, that it never completely separates from them.

Butter can be obtained from cream, when sweet and newly taken from the milk; but it then requires, according to Fourcroy, four times as much churning as after it has become sour by standing. It appears, therefore, that by being kept, cream acquires new properties, in consequence of which, it can be with greater facility converted into butter. This can by no means be equally well obtained from the milk of every sort of animal. Indeed, the milk of some of them can never be made to yield any butter. No length of churning will produce it from the cream of woman's milk, or of mare's milk; while, on the contrary, the cream of goat's milk, and ewe's milk, yield it in abundance, and with as much facility as the cream of the milk of the cow, from which it is almost always made. The cream of asses milk, when long agitated, yields a soft, white, insipid butter, which has the singular property of again mixing very readily with the butter-milk, and of being capable to be again separated from it, by agitating the containing vessel under cold water.

When butter is kept for a certain time, it acquires a peculiar disagreeable smell and taste, known by the name of rancidity. This has been thought to arise from the developement of a peculiar acid, similar to, if not the same with, the sebacic acid. But Deyeux and Parmentier have shewn, that no acid is present in rancid butter. Rancid oils, however, certainly do shew acid properties. The disposition of butter to become rancid, is owing in a good measure to the presence of foreign matters adhering to it; for if the butter be carefully washed, so as to separate completely the serous and curdy parts, rancidity does not take place nearly so soon.

When butter is distilled, we obtain a little water and sebacic acid; the greatest part of the butter comes over in the state of an oil, with a strong, pungent, and very disagreeable smell; much carburated hydrogen gas is disengaged, and there remains in the retort a very small carbonaceous residuum, with a little phosphat of lime.

The most approved modes of preparing butter, the circumstances which influence its goodness, the uses to which it is put, and the best methods of preserving it, with its importance as an article of commerce, will be mentioned afterwards. Meanwhile, we observe, that this substance seems to have been very imperfectly, if at all, known to the ancients.

The word butter is no doubt from the Latin *butyrum*, and that from the Greek *βȣτυρον*, which is generally stated to be a compound of the two words *βȣς*, *bos*, and *τυρος*, *coagulum*; while others contend that *βȣτυρον* is not of Greek origin, but derived from the language of the Scythians, from whom the Greeks first obtained the knowledge of butter. Certain it is, that Hippocrates is the first Greek author who mentions *βȣτυρον*. Speaking of the Scythians, he says, "they pour the milk of their mares into wooden vessels and shake it violently; this causes it to foam, and the fat part, which is light, rising to the surface, becomes what they call butter (*ὁ βȣτυρον καλεȣσι*)" Herodotus also, who was cotemporary with him from the year B. C. 459 to B. C. 413, particularly describes the process of making butter among the Scythians. This affords a presumption that the article was not then known among the Greeks, and that they acquired the knowledge of *βȣτυρον*, and the practice of making it, from the Scythians.

Some have imagined that they found butter mentioned in the writings of Moses, the book of Job, and other parts of the most ancient sacred scriptures. According to our translation, Abraham is said, Gen. xviii. 8. to have taken *butter* and milk, and the calf that had been dressed, to set before the august strangers who visited him. And in the well-known song, or historical ode of Moses, which he recited in the hearing of the Israelites, a short time before his death, (Deut. xxxii. 14.) we have the words "butter of kine." Butter is also mentioned in the song of Deborah and Barak, Judges v. 25. Certain friends (2 Sam. xvii. 29.) are said to have brought to Mahanaim, butter and other articles, for the refreshment of David and his army during the rebellion of his son Absalom. Honey and butter are also mentioned Job xx. 17; and in chap. xxix. 6. he says, "When I washed my steps with *butter*, and the rock poured me out rivers of oil." Butter and honey are also mentioned in the well-known passage in the 7th chapter of Isaiah, where the prophet foretels of the child, that he should eat *butter* and honey. And in the 30th chapter of the Proverbs it is said, "the churning of milk bringeth forth butter." But it is to be observed, that in all these passages, the Hebrew word is חמאה, *hemâe*, which biblical critics agree in allowing to signify sour thick milk or cream. Besides, it is plain that *hemâe* alludes to something fluid, for it was used to wash the feet. The error of supposing *hemâe* to mean a concrete substance like butter, appears to have arisen from the Septuagint, who translate the Hebrew term by *βȣτυρον*, a word which, as they lived in Egypt two centuries after Hippocrates, they might no doubt have heard of, and supposed to correspond to the Hebrew word *hemâe*. That they meant, however, no more than cream by the term *βȣτυρον*, is highly probable. No doubt, the common translation of the passage already quoted from the Proverbs, may be thought to prove clearly that the making of butter by churning was well known among the Hebrews. But the original words מיץ חלב, *meetz heleb*, signify to squeeze or press; and might have been as well translated "the pressing of the milker bringeth forth milk." And this accords better with what immediately follows, viz. "and the wringing of the nose bringeth forth blood."

It was late before the Greeks appear to have had any knowledge of butter. No mention is made of it by any of their early poets. Homer, Theocritus, and Euripides, though they frequently speak of milk and cheese, say nothing of butter: and Aristotle, in his *History of Animals*, at first assigns to milk only two component parts, viz. the serous and the caseous; though afterwards he remarks, as it were by the bye, that there is likewise found in milk a fat substance, which, under certain circumstances, is like oil. Hippocrates, as we have already remarked, is the first Greek writer who mentions butter; and he frequently prescribes it as an external application under another name, viz. *πικεριον*. But Galen, who wrote in the end of the second century, does not use this term. It seems to have been of Phrygian extraction. The poet Anaxandrides, who flourished a short time after Hippocrates, describing the wedding of Iphicrates, who married the daughter of Cotys king of Thrace, and the Thracian entertainments given on that occasion, mentions the use of butter for food among these people as a matter of curiosity; a sure proof that it was not so employed among the Greeks.

Strabo, who flourished about thirty years before the Christian era, says the Lusitanians and Ethiopians used butter instead of oil. And Ælian, who lived in the end of the first century, says that the Indians employed butter to anoint the wounds of their elephants. Plutarch, who was his cotemporary, speaks of a visit paid by a Lacedemonian lady to Berenice the wife of Deiotarus, which, according to him, seems not to have been mutually agreeable; for he says the one smelled so much of butter, and the other of perfume, that neither of them could endure the other.

Dioscorides (B. C. 33,) is the first author who recommends butter as an article of diet, and says it might be melted fresh, and poured over pulse and other vegetables instead of oil, and used in pastry. He also recommends it for medicinal purposes. But Galen, who wrote at Rome about 200 years later, is much more full on the healing virtues of butter. He is surprised that Dioscorides should have said it was made of sheep's and goat's milk, for he himself had seen it made of cow's milk; and such butter, he affirms, was always the fattest and best, and had from thence, he believes, derived its name. He says it may be used instead of oil in mollifying leather, and that in cold countries which did not produce oil, butter was used in the baths, and was evidently a real fat, because, when poured over burning coals, it readily caught fire. From all this it is evident, that butter in his time must have been very little known to the Greeks and Romans.

Strabo, speaking of the ancient Britons, says, that though they had abundance of milk, some of them were so ignorant that they did not know how to make a cheese. But Pliny, on the other hand, affirms, that "the barbarous nations," by which he usually means the Germans and Britons, not only made cheese, but likewise butter, which they used as a most agreeable food; and the use of this food was a distinguishing mark betwixt the rich and the poor. To these nations he ascribes the invention of butter, and says they made it from the milk of the goat, the sheep, and the cow; most commonly from the latter, but that the milk of the ewe produced the fattest butter. He likewise describes the form of the vessel employed by the barbarians in making it, which seems to have been not very different from what we now use. It was covered, he says, and had holes in the lid. He is the first Latin writer who mentions the word *butyrum*, though Vossius thinks it is to be found in Columella. Whether Tacitus, by *lac concretum*, which he affirms to have been the most common food of the Germans, means cheese or butter, it is impossible to determine.

The Greeks, then, seem to have derived their first acquaintance with butter from the Thracians or the Scythians, and the Romans from the Germans. Nor did either of them, after learning its nature, employ it as an article of food, but only as an ointment in their baths, and in medicine. Their agricultural writers, who treat largely of milk, cheese, and oil, as food, take no notice of butter, nor is it mentioned by Apicius. The suggestion of Dioscorides, therefore, formerly mentioned, that butter might be conveniently used in cookery, seems not to have been attended to. Fourcroy thinks, that the effect of agitation in separating butter from milk, must have been accidentally made by the Scythians or other wandering tribes while transporting their milk from place to place in skins or other vessels.

Sidonius Apollinaris informs us, that the ancient Burgundians were accustomed to besmear their hair with butter; and Clemens Alexandrinus says, that the ancient Christians of Egypt burned butter in their lamps at their altars instead of oil; a practice somewhat similar to which has been retained by the Abyssinians. In the Roman Catholic churches, it was anciently allowed, during Christmas time, to use butter instead of oil, on account of the great consumption of this in other ways. This accounts for the name "butter tower," which we find in some places, as at Rouen, Notre Dame, and others. In 1500, George d'Amboise, Archbishop of Rouen, finding the oil fail in his diocese during Lent, permitted the use of butter in their lamps, on condition that each person should pay six deniers for the indulgence, with which sum this tower was erected.

From all the accounts of the method of making butter transmitted to us by the ancients, we have reason to think that they were unacquainted with the art of giving it that firmness and consistence which is so valuable a quality of modern butter. They always speak of it as a liquid substance. With them it was poured out like oil; with us it is cut and spread. Their butter was probably much inferior to ours, and its use very limited.

The processes for making butter have been various in different ages and among different nations. The operation of churning is well known; and we have only to observe, that though churns have been constructed of different forms, they may be all reduced to two, the vertical and horizontal. The vertical, or pump churn, as it is usually named, was probably the first thought of, and is nothing more than a tall wooden vessel, three or four feet high, narrow in proportion to its height, and straiter above than below, having a sort of piston or staff, adapted to it, with a perforated head, by moving which up and down with the hands, the cream is agitated, and the butter at length formed. The utensil is sufficiently well adapted to the operation of making butter on a small scale, where the cream to be churned is the produce of a few cows only. But where dairying is managed on the great scale, and the quantity of cream large, the operation performed in this way is too tedious and laborious for general use, and methods have been contrived to expedite the process and abridge the labour. This is best done by means of the horizontal, commonly called the barrel-churn, which is a cylindrical vessel, close at both ends, and firmly fixed upon a stand, having a sort of rack or trundle adapted to it within, usually with four blades, and turned by a winch or handle, placed on it's axle, passing through the ends of the churn. By this machine, as much cream may be churned in an hour as could be done in ten or twelve by the common upright churn.

Ingenious machinery for working both species of churns, by means of water, and other moving powers, have been contrived, and found to answer well.

In the northern parts of Africa, in Egypt, and Arabia, they churn by putting the cream into a goat's skin, turned inside out, and pressing it to and fro, in an uniform manner. Sometimes they place it on an inclined plane, permitting it to roll to the bottom, and then again replacing it to run the same course. A method which in a short time produces butter.

Dr Chandler, while travelling in Greece, observed them treading the skins thus filled with their feet; a practice which has been thought to illustrate the passage already quoted from the book of Job.

In Bengal, they churn by simply turning a stick in the milk; and that families may have the butter fresh and sweet to breakfast, it is made in this way every morning. In many parts of the East, they make butter of the milk of the buffalo; but this is by no means esteemed equal in excellence to the butter of the cow's milk. It is deficient in consistence, colour, and flavour.

With regard to the good or bad qualities of butter, a great deal has been always ascribed to the pasturage of different farms or districts. Recent observations and experiments, however, shew that much less depends upon this than has been commonly imagined. The mode of management appears to be of much greater consequence. " In every district," says Dr Anderson, " where fine butter is made, it is universally attributed to the richness of the pastures, though it is a well known fact, that take a skilful dairy-maid from that district into another, where no good butter is usually made, and where, of course, the pastures are deemed very unfavourable, she will make butter as good as she used to do; and bring one from this last district into the other, and she will find that she cannot make better butter there than she did before, unless she takes lessons from the servants or others whom she finds there."—" I have frequently," continues he, " known instances of this kind. And the same thing takes place in the manufacture of beer and many other articles. In matters of this sort, a very great diversity is produced by circumstances apparently of a most trivial kind."

M. Tessier, of the National Institute of France, says, " The particular nature of Bretagne butter, whose colour, flavour, and consistence, are so much prized, depends neither on the pasture nor the particular species of cow, but on the mode of making. This butter is of a superior quality, because they make it of the richest cream, and usually in large quantities at a time. As soon as it is made and washed, they sprinkle it with sweet milk, spread it out in flatted cakes, larger or smaller, but rarely containing less than three, or more than six pounds; and lay it on a kind of pan, placed on hot cinders, and covered with a copper lid, on which are put cinders also. It remains there some minutes, more or fewer according to the bulk of the cake."

This mode of managing butter appears from him to be a secret in certain families, and to require practice and dexterity to conduct it with success.

Still, however, we are disposed to believe that certain pastures are more favourable to the production of good butter than others. Certain plants, such as turnip, wild garlic, hemlock, rough-leaved dandelion, charlock, and may-weed, are known to affect milk with a disagreeable flavour, and there may be many others which, to a certain degree, impair its goodness, though their effects are by no means so evident. Far more, however, depends on good management than on this circumstance, or even on the species of cow we feed; for that something, likewise, is owing to this, is equally well ascertained. Cows have been found whose milk could not be brought to yield any butter at all.

It has been long remarked, that the butter in the Highlands of Scotland, when properly made, possesses a peculiarly rich and delicate flavour; and this has been almost universally attributed to the old grass on which the cows feed in these remote glens. But what more common error than to mistake a concomitant circumstance for a cause? Dr Anderson, by his experiments on milk, has shewn that the excellence of the Highland butter may be very reasonably ascribed to a quite different cause. He has proved that the cream of a given measure of milk constantly increases in quantity, and still more in quality, from the first drawn tea-cup full, to the last drop that can be squeezed from the udder at the time. " Probably," says he, " on an average of a great many cows, the proportion of the cream obtained from a given quantity of the last drawn milk, may be to that of the cream obtained from an equal quantity of the first drawn, as ten or twelve to one; but the quality of the cream of the last drawn was still more superior than its quantity. The cream of the first drawn tea-cupful of the milk was only a thin white film; in the last, it was of a thick butyraceous consistence, and of a glowing richness of colour, such as no other cream possesses. It is, therefore, observes Dr Anderson, of much more importance than is commonly imagined, to milk the cows well; for on the cream of the last drawn milk depends entirely the richness and delicate flavour of the butter." Now, in the Highlands of Scotland, where they rear almost all their calves, the common practice is to admit the calf to suck the mother always for a certain time before milking. And when the dairy-maid judges the calf has had enough, it is removed to the pen or *cruive*, from which it had been brought. In this way, the latter drawn parts of the milk only are obtained for the dairy; and the cream produced from it being of a superior quality, the excellence of the Highland butter seems to be accounted for. In the higher districts of Galloway, a similar mode of management prevails, and their butter is observed to be rich and delicate. It has been likewise ascertained, that the cream which first rises after the milk has been deposited in the dairy-pans, is both much greater in a given space of time, than that which rises in an equal space several hours after, and of a greatly superior quality; that thick milk throws up less cream than thin, but of a richer quality; and that milk that has been much agitated by carrying, and cooled before it is put into the milk-pans, never throws up so much cream, as that which is immediately deposited in them after milking. It is also known, that the milk is not at the best till about four months after the cow has calved; and that the degree of heat most favourable to the production of cream from milk, is from 50 to 55 degrees of Fahrenheit's thermometer. " If the heat of the milk-house," says Dr Anderson, " be too great, the milk suddenly coagulates, without admitting of any separation of the cream; or it is so quickly turned sour, as greatly to mar the operation. If, on the other hand, the milk be exposed to too cold a temperature, the cream separates from it slowly, and with difficulty; it acquires a bitter and disagreeable taste; the butter can scarcely be made to come at all; and when it is come, it is so pale in the colour, so small in quantity, and of such hard and brittle consistence, so poor to the taste, and of so little value in all respects, as to bring a very low price at the market, compared to what it would have produced, had it been preserved in a proper degree of heat." The same judicious writer states it as his opinion, formed from experience and attentive observation, that since neither cream nor butter can be produced from milk, till some portion of an acid be evolved in it, the last drawn half of the milk only should, in general, be set up for producing cream, and be allowed to stand till it throw up the whole of its cream, even till the milk tastes perceptibly sourish; and that if this cream be afterwards judiciously managed, the butter thus obtained will be of a greatly superior quality to what can be usually got at market, and its quantity not considerably less, than if the whole of the milk had been originally set apart for producing cream. " This, therefore," says he, " is the practice that I should recommend, as most likely to suit the frugal farmer; as his butter, though of a superior quality, could be afforded at a price that would always ensure it a rapid sale."

Cows, in summer, should be milked three times a-day at least; early in the morning, at noon, and just before night-fall. If this be not done, the greatest possible quantity of milk will be far from being obtained from them. The milk is secreted in the udder, very much in proportion to the quantity required, as we see in the case of dogs, cats, pigs, and other animals, which produce more young than one at a time; and we know that a cow, by scanty milking, can very soon be put dry. It is therefore of the utmost consequence, that the whole milk secreted be at each milking carefully drawn away. It may be laid down as a pretty general rule, that 18 pounds of milk will yield one pound of butter; and that this is the produce of a single cow per day. Some, however, will furnish twice, or even thrice this quantity. The effects of feeding, treatment, management, and the idiosincracy of particular animals, are here astonishingly great.

From 12 to 20 hours in summer, and about twice as long in winter, should be permitted to elapse before the milk is skimmed, after it has been put into the milk-pans. If, on applying the tip of the finger to the surface, nothing adheres to it, the cream may be properly taken off; and during the hot summer months, this should always be done in the morning, before the dairy becomes warm. The cream should then be deposited in a deep pan, placed in the coolest part of the dairy; or in a cool cellar, where free air is admitted. In hot weather, churning should be performed, if possible, every other day; but if this is not convenient, the cream should be daily shifted into a clean pan; and the churning should never be less frequent than twice a-week. This work should be performed in the coolest time of the day, and in the coolest part of the house, where there is a free draught of air. Cold water should be applied to the churn, first by filling it with this, some time before the cream is poured in, and then by immersing it in water to the depth of a foot or so, during the operation, provided we use the pump-churn; or by applying wet cloths to it, if we use a barrel-churn. Such means are generally necessary to prevent the too rapid acidification of the cream, and formation of the butter.

The winter season and cold weather, of course, require an opposite practice; but we can hardly be too cautious in the application of heat; for the common practices of wrapping the churn in a warm cloth, plunging it into hot water, adding warm milk to the cream, or placing the churn near the fire, all tend to injure the butter. The best way perhaps is to heat the churn, by filling it with boiling water before the cream is put in, and to place it in the warmest part of the house; but not close by a fire.

The operation of churning ought to be moderate, equable, and uninterrupted; for if we stop or relax in our exertions, the butter will *go back*, as it is called; and if the motion be too quick and violent, the butter will imbibe a very disagreeable flavour. This, in some districts of Scotland, is known by the phrase *bursting* the churn.

Machinery, as before observed, of an ingenious and convenient construction, is in some districts now employed, and found to have the advantage, not only of abridging labour, but of securing a more regular and uniform motion.

When the operation is properly conducted, the butter, after some time, suddenly forms, and is then carefully collected and separated from the butter-milk. But in doing this, it is not sufficient merely to pour off this milk, or withdraw the butter from it; because a certain portion of the caseous and serous parts of the milk still remain in the interstices of the butter, and must be detached from it by washing, if we would obtain it pure. In washing butter, some think it sufficient to press the mass gently betwixt the hands; others press it strongly and frequently, repeating the washings till the water come off quite clear. The first method is preferable, when the butter is made daily for immediate use, from new milk or cream; because the portions of such adhering to it, or mixed with it, contribute to produce the sweet agreeable flavour which distinguishes new cream. But when our object is to prepare butter for keeping, we cannot repeat the washings too often, since the presence of a small quantity of milk in it, will, in less than 12 hours after churning, cause it sensibly to lose its good qualities.

The process of washing butter is usually nothing more than throwing it into an earthen vessel of clear cool water, working it to and fro with the hands, and changing the water till it come off clear. A much preferable method, however, and that which we believe is now always practised by those who best understand the business, is, to use two broad pieces of wood instead of the hands. This is to be preferred, not only on account of its apparently greater cleanliness, but also because it is of decided advantage to the quality of the butter. To this the warmth of the hand gives always more or less of a greasy appearance; and butter washed by means of the wooden *flappers*, as they are called, will always fetch at market a higher price than if the hand had been employed. The influence of the heat of the hand is greater than might at first have been suspected. It has always been remarked, that a person who has naturally a warm hand, never makes good butter.

After washing, the butter should be cut and sliced in every possible direction, with a serrated or rough-edged knife, in order to bring out from it the smallest hair, bit of rag, strainer, or any thing that may have chanced to fall into it. It is then to be spread in a bowl, and such a quantity of salt added as may be judged proper. If the butter is to be used immediately, or kept only for a short time, a small proportion will be sufficient; and in this state it is usually denominated *fresh* butter. But if it be intended to be long kept, or transported to a distance, an ounce or two of salt will be required to the pound of butter. The salt used in curing butter should be of the purest kind, well dried, and broken down, but not completely pulverized; and it must be so thoroughly worked in, as to be equally incorporated with the mass.

When butter is to be sold on the spot, or in the neighbouring markets, it is divided into rolls of a pound, or half a pound; or into lumps of 24 ounces, called dishes in some parts of England; but when it is to be kept, or carried to a distance, quantities of 84, 56, or 28 pounds, are put up together in casks, usually called tubs, firkins, and half firkins.

When the butter has been sufficiently impregnated with the salt, by being spread out in thin layers, sprinkled with it, and thoroughly wrought, it is then to be gently pressed into the tub or firkin, which must not, however, be filled quite up, but room left at top to receive a layer of salt, half an inch or an inch in thickness. In seven or eight days, the salted butter detaches itself from the sides of the firkin, shrinks, and occasions interstices. These, if allowed to remain, would injure the butter, by admitting the contact of the air. They are, therefore, to be filled up by a saturated solution of salt in water, or brine strong enough to carry an egg. The butter is then to be covered by a new layer of salt, and the head of the vessel put on.

Before the butter is put into the firkin, care must be taken that the latter be well seasoned: and this is effected by exposing it for two or three weeks to the air, and frequent washing. The readiest method, however, is by the use of unslaked lime, or a large quantity of salt and water well boiled, with which it should be scrubbed several times, and afterwards thrown into cold water, to remain three or four days till wanted. It should then be scrubbed as before, and well rinsed with cold water; and before receiving the butter, every part of the inside of the firkin must be carefully rubbed with salt. Indeed, the surest of all methods to preserve butter from spoiling, after it has been properly salted, is to keep it constantly immersed in a saturated solution of this substance. A friend of the writer of this article informs him, that he has preserved butter in this manner at sea for a very long period. It might deserve attention, to try to discover a species of wood that would not communicate any taste to the butter.

An excellent composition for preserving butter may be prepared, by mixing one part of saltpetre, one of common salt, and two of sugar. This thoroughly wrought into the butter, will keep it sweet for a very long time, and communicates to it no salt or disagreeable taste.

When butter is to be exposed to the heat of a warm climate, it should be purified by melting, before it is salted and packed up. Let it be put into a proper vessel, and this into another containing water; let the water be gradually heated till the butter be thoroughly melted; let it continue in this state for some time, and the impure parts will subside, leaving at the top a perfectly pure transparent oil. This, when it cools, will become opake, and assume a colour nearly resembling the original butter; being only a little paler, and of a firmer consistence.

This refined butter must be separated from the dregs, salted, and put up in the same way with other butter; and it will keep much longer sweet in hot climates, as it retains the salt better. It may also be preserved sweet, without salt, by adding to it a certain proportion of fine honey, and mixing them thoroughly, so that they may be perfectly incorporated. A mixture of this sort has a sweet pleasant taste, and will keep for years without becoming rancid. It might of course be very useful in long voyages. Dr Anderson thinks an ounce of honey sufficient to preserve a pound of butter.

To preserve butter for a long time fresh without any foreign mixture, the best method perhaps is, first of all to wash the butter-milk completely out, and then to keep the butter under pure cool water, frequently renewed. Some wrap it up in a wet linen cloth, to defend it from the influence of the air. But though fresh butter be kept cool and from the air, it will in no very long time become rancid. We cannot by any means keep it fresh from one year to another, or transport it to a distance in good condition. Rancid butter, to most people, is extremely disagreeable. A very small quantity of it will be observed by many in a large mass of meat, that it may have been employed to season. Few stomachs can digest rancid butter. Some are so delicate, that the use even of fresh butter, of milk, of cream, and in general of all oleaginous substances, affect them with difficult and painful digestion.

Butter, to be a wholesome aliment, must be free from rancidity, and not fried or burned. But even in its purest state, there are few who can indulge very freely in the use of this article with impunity; and health, perhaps, would not suffer, though its employment as food were altogether laid aside. Like the other bland oils, it is gently laxative.

Most housewifes know several receipts for restoring rancid butter to freshness. But of these the greater number are of little use. Washing it well with pure water, or with ardent spirit, still better perhaps with sweet milk, will deprive it in some measure of its disagreeable smell and taste. It is of much more consequence to preserve butter from becoming rancid, by salting, and the other means already explained.

As turnip is now become so common a food for cows, and often imparts to their milk, and the butter thence made, a very disagreeable flavour, it is of some consequence to know how this may be best obviated. A small quantity of saltpetre has been recommended; and in the *Georgical Essays*, vol. v. we have the following method: "Let the bowls or pans be kept constantly clean, and well scalded with boiling water before using.* When the milk is brought into the dairy, to every eight quarts mix one quart of boiling water; then put up the milk into the bowls to stand for cream." Dr Anderson says, "that if the milk is to be used sweet, its taste may be considerably diminished by boiling; and that other means of sweetening milk have been attempted, more troublesome and expensive, and not more efficacious."

As butter made in winter is generally pale or white, and its richness at the same time inferior to that which is made during the summer months, the idea of excellence has been associated with the yellow colour. Means are therefore employed by those who prepare and sell butter, to impart to it the yellow colour where that is naturally wanting. Various substances have been used for this purpose,but they must all be of the resinous class, or such as are soluble in oils. Extractive matters, and such as are soluble only in water, alcohol, &c. as beet-root and cochineal, give no tinge to butter. The substances most commonly employed are the root of the carrot, and the flowers of the marigold. The juice of either of these is expressed and passed through a linen cloth. A small quantity of it, (and the proportion necessary is soon learned from experience,) is diluted with a little cream, and this mixture is added to the rest of the cream when it enters the churn. So little of this colouring matter unites with the butter, that it never communicates to it any peculiar taste.

Many other colouring matters have been employed, as saffron, the berries of the physalis alkekengi, the seed of the asparagus; but the marigold and carrot are certainly the best; and it is the latter that is chiefly used by the best farmers.

Alkanet root will give every shade of colour to butter, from the lightest rose to the deepest red, by augmenting or diminishing the proportions of it.

Though the milk of the cow, when fed on rich pasture during the summer months, is almost always found to produce butter of a rich yellow colour, this is by no means the case with every animal. The goat, the sheep, the mare and the ass, fed on the same pasture in the same season, produce milk which yields butter always more or less white.

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* It can hardly be necessary to observe, that the utmost attention to cleanliness with respect to every vessel and instrument used, and every operation performed in the making of butter, is indispensably requisite, any neglect of this kind is fatal to its goodness. It is quite necessary that the bowls or pans, after scalding, be allowed to cool before the milk is put into them.

Butter, as an article of commerce, is of considerable importance. Some compute that there are 112,000,000 pounds of it annually consumed in London, chiefly made within 40 miles round the city. From the three counties of York, Cambridge, and Suffolk, there are annually sent to the capital 210,000 firkins, amounting to 11,760,000 pounds.

Some counties or districts are particularly famous for the excellency of their butter. That which is made in Essex, and well known under the name of Epping butter, is the most highly esteemed of any in London and its vicinity. In the more restricted use of this appellation, it is applied only to the butter made from the milk of cows which are fed in Epping forest during the summer months, where the leaves and some particular plants are thought to contribute to its superior flavour. In Somerset butter of nearly the same excellence is made; but brought to market in half pounds instead of pounds.

The Cambridgeshire salt-butter is held in the highest esteem. And the London cheesemongers, by washing and detaching the salt from it, often sell it at a high price for fresh butter. It is made nearly in the same way as the Epping butter, and when salted, put up in firkins of 56 pounds. Yorkshire and Suffolk butter is very little inferior to that of Cambridgeshire, and is often sold in London for such. Utoxeter, in Staffordshire, has long been famous for good butter. The London cheesemongers have a sort of factory there for this article. It is bought by the pot, of a cylindrical form, weighing 14 pounds.

The superior excellence of the butter produced in the Highland districts of Scotland, has been already remarked, and we hope accounted for. The same delicately flavoured species is said to be made on the mountains of Wales, and the heaths and commons of England. Whether the same reason will apply here, we have no means of ascertaining.

Frauds and abuses of various kinds are practised in the salting and packing of butter, to increase its bulk and weight. Pots are frequently laid with good butter for a little way at the top, and with bad at the bottom. Sometimes the butter is placed in upright rolls, touching one another above, so as to form a uniform surface, but receding so as to leave empty spaces below. Sometimes tallow or hogs-lard is found to constitute no small proportion of what the purchaser had deemed good butter. To prevent these cheats, the factors at Utoxeter keep a surveyor, who, in case of suspicion, tries the pots with an iron instrument, called a butter-bore.

An act of parliament (36th Geo. III. c. 86.) particularly regulates the packing, salting, and selling of butter. By that statute it is enacted, that every vessel made for the packing of butter, shall be of good well-seasoned wood, marked with the maker's name, and, by a subsequent act, his place of abode; that it shall be a tub containing 84, a firkin containing 56, or a half firkin containing 28 pounds, avoirdupois, and no other; that it shall be of a particular weight, and neither top nor bottom exceeding a certain thickness, having the true weight or tare of the vessel distinctly marked upon it; with a variety of other regulations to prevent frauds, under severe penalties. Any fraud with regard to the butter, the vessel, or its marks, subjects the person concerned to a forfeiture of 30*l.* for every such offence. See Fourcroy *Systeme des Connoissances Chimiques*, tom ix. Deyeux and Parmentier, *Memoire sur le lait.* Thomson's *Chemistry.* Anderson's *Agricultural Recreations*, vol. iii. and iv. Anderson's *Essays on Agriculture. Mid Lothian Report*, 1795. (z)

BUTTERMERE. See Cumberland.

BUTTNERIA, a genus of plants of the class Pentandria, and order Monogynia. See Botany. p. 147.

BUTTON Manufacture. It will, perhaps, excite some surprize, among persons unacquainted with manufactures, that the fabrication of such trifling articles as buttons should give employment to many thousands of the inhabitants of Birmingham, Sheffield, and other large towns in Great Britain; and that several very curious and expensive machines are used to lessen the manual labour.

The manufacture of buttons is divided into several kinds, the formation of each of which is a distinct business; the manner of fabricating them varying as greatly as the materials from which they are made. Horn, leather, bone, and wood, are the substances generally employed for buttons which are either plain, or covered with silk, mohair, thread, or other ornamental materials. The most durable and ornamental buttons are made of various metals, polished, or covered with an exceeding thin *wash*, as it is termed, of some more valuable metal, chiefly tin, silver, and gold.

Those buttons intended to be covered with silk, &c. are termed, in general, moulds. They are small circles, perforated in the centre, and made from those refuse chips of bone which are too small for other purposes. These chips, which, for the large and coarser buttons are pieces of hard wood, are sawn into thin flakes, of an equal thickness; from which, by the machine, as delineated in Plate CVII. Fig. 1. the button moulds are cut out at two operations. The lathe, as usual, is put in motion by a wheel A turned by the foot, by means of a treadle B, and crank *a*. The strap *c* gives a rapid rotatory motion to the spindle D, mounted on its pivot in an iron frame. One end of the spindle has a tool *b*, shewn enlarged at L, screwed into it, and moving along with it; and the other extremity of the spindle is connected by a peculiar kind of joint, with a lever *e f*, whose fulcrum is *e*; the other end *f* being connected with a second lever and handle *g*, which the operator holds in his left hand. The right hand is, at the same time, employed in holding the flake of bone *d* opposite the tool *b*, against a piece of wood firmly fixed into the iron standard E by two screws; then, by drawing the handle *g* forwards, the tool *b* being at the same time in rapid motion by the foot wheel, its centre pin *k* (see the separate view at L) is pressed against the bone, and drills a hole through in the centre of the intended button; and its two points *h*, *h* describe a deep circle in the bone, about half through its thickness. The flat surface is cut smooth by the parts *m*, *m* of the tool. The piece of bone is now moved a small distance, to cut out another button from a fresh part; and when as many as the flake of bone will contain are thus cut half through, the other side is presented to the tool. The point *k* is inserted into the hole made from the other side by the former operation. The two teeth *h*, *h* of the tool now cut another deep circle, exactly opposite the former, at the same time cutting the flat surface smooth. By this means the bone is cut through, and a button mould left sticking on the point of the tool.

By drawing back the handle *g* the tool recedes, and the button meeting a fixed piece of iron plate, is forced off the tool, and falls into a small box at F, completely finished. Another part of the bone is now presented to the tool, to cut out another mould. These operations are conducted with such rapidity, that a girl of ten or twelve years of age is enabled to cut out twenty-five or thirty buttons per minute. The larger kind of buttons are first cut from the pieces of bone, and the smaller ones are afterwards made from the spaces left between the first; so that the materials are made to yield the utmost to the button-maker, and the remains are afterwards sold to farmers for manure. The shavings, sawdust, and more minute fragments, are used by manufacturers of cutlery and iron toys, in the operations of case hardening; so that not the smallest waste takes place. Hard wood is cut into buttons in the same manner, and afterwards dyed black in an infusion of sulphat of iron and gall nuts. Oak, beech, or elder, is chiefly used, but only for large buttons, all the smaller kinds being made of bone.

Button moulds are only used at present for the purpose of sewing up in a piece of the same cloth as the garment to which they are attached. They were formerly covered with the most costly materials, by women, who were seated round a table, and each had a large needle fixed in the table opposite the part where she was seated, and also a bobin, containing the thread to cover the button. The mould was stuck by the hole in its centre upon the needle, and the end of a thread of silk, mohair, and sometimes gold thread, put through the centre at the same time, to fasten one end; the thread was then wound about the button mould to cover it, and present an ornamental surface, such as the fashion of the day, or the fancy of the maker directed. As this art is now obsolete, one pattern, Plate CVII. Figs. 2, 3, and 4, from many thousands in vogue thirty years since, will give an idea of the disposition of the covering. Fig. 2. is the button just beginning to be covered; Fig. 3. the same in an advanced stage; and Fig. 4. is a finished button. The thread being fastened at the centre in the back, (see Fig. 2.) is brought to the circumference on the dotted line 1, and wound across the front, as shewn at 2. It then passes behind again, on the dotted lines 3, and in front at 4; across the back on the dotted line 5, in front at 6; and passing behind on the line 7, is laid in front at 8; making a complete square in front. By continuing this process, and laying the threads beside each other, the square becomes less, as in Fig. 3; where the Numbers 9, 19, 11, 12, 13, 14, 15, 16, again denote the progress of the thread, which alternately passing over and under the former folds, the intersections form the appearance which begins to be visible at the angles *a*, *b*, *c*, *d*. As more thread is wound on the four sides of the square, 10, 12, 14, and 16, meet round the centre pin, and the mould is completely covered, as in Fig. 4. The end of the thread is fastened by sewing it through the centre; and, in some cases, by placing a small ornament upon it. In others, a number of the last folds which are wove round the needle upon which the mould is fixed, and therefore do not perfectly unite in the centre, are drawn together by passing the thread round them before it is sewed through the centre. At the back, a great number of the folds of thread are taken up and tied together by a strong thread, to serve the purpose of a shank to sew the button to the garment: This, at the same time, prevents the folds of thread at the back from slipping over the edge of the mould. In this state the common buttons were finished; but the finer kinds were afterwards ornamented with wire, or threads covered with silk or gold, woven in the threads of the plain button, in various fantastic patterns; one of which is shewn in Plate CVII. Fig. 5. Sometimes the moulds were sewn up in pieces of cloth elegantly wove of gold, silk, white horsehair, &c. and ornaments in gold or silver were sewed on the surface. All such buttons were, after covering, exposed in a sort of cullender over the flame of burning spirits of wine, to remove the small filaments of silk projecting from their surface, and render them smooth: the workman keeping them in constant motion during this process, to avoid burning or damaging the buttons. They were afterwards cleaned, by shaking a great number in a bag with crumbs of bread: this took off the end of the singed fibres, rendering them glossy, and ready for sale.

Horn buttons are made sometimes with shanks fixed in them; and others, called Sailors' Buttons, are fastened to the garment by sewing through four holes made in them for that purpose; and the surface is concave in front, to preserve from wearing the thread by which they are sewed. They are made from cow-hoofs, by an ingenious process of pressing them into heated iron moulds. The hoofs being boiled in water till they become soft, are cut into parallel slips by a cutting knife, which is a blade, with a long handle at one end, and jointed to the bench by a hook and eye at the opposite extremity. It then acts like a lever in cutting the horn placed beneath its edge. The slips being the width of the diametor of the intended button, are cross-cut into small squares; and the angles of these being cut off, leaves octagonal pieces nearly the size of the intended buttons. These are dyed black, by dipping them into a cauldron of water impregnated with logwood and copperas. After being dried for a week, they are then ready for pressing between the moulds, Plate CVII. Fig. 6. which consist of two plates of iron *a*, *a*, united by the joint of the handles *b*, *b*, to open and shut. Each plate *a*, *a*, has six, eight, or twelve small steel dies fastened to it, each die containing the impression of the intended buttons embossed in it. When shut close, these impressions exactly correspond. The two claws *c*, *c* enter corresponding cavities in the opposite plate, and insure them coming accurately together. The presser, being provided with a great number of different moulds, arranges them in an oven or furnace, till they become heated somewhat above the heat of boiling water. A piece of horn is then placed upon each impression in the mould, which is shut close, and the mould is placed in a small screw press fixed to the work bench, which holds the moulds shut together for a few minutes, till the horn is warmed and softened by being between them. The mould is now carried to the pressing vice, Plate CVII. Fig. 7. which consists of two massive cheeks A, A, united by the joint-piece B, and drawn together by the screw C. This vice is fixed in an inclined position against a post D. The mould, with the horn in it, is put between the cheeks A, A, very near the centers B, and is pressed so violently by the combined power of the screw and lever, that it indents the horn into the exact pattern formed in the moulds. The horn remains in this state for about twenty minutes, till the mould is cool. Nine presses are usually arranged round the stove, and these find continual employment for one man. It is necessary to keep the buttons in the vice till cold, otherwise they would resume their original figure.

The fashes, or edges of the buttons, which did not enter into the cavities of the dies, are now clipped off by shears, and are then filed smooth and round in a lathe, consisting of a spindle like that in Plate CVII. Fig. 1. and another nearly the same, placed exactly in the same line, but opposite to the former. Both are turned with the same velocity, by straps from two equal foot-wheels on one axis. The ends of the two spindles come in contact, and have chucks, with a cavity in each for the reception of the button. The spindle, like D, is pressed forwards by a spring applied to the lever *e f*, so as to hold the button fast between them, and turn it round while it is filed. When a button is finished, the attendant, without stopping the lathe, pushes the handle *g*, Fig. 1, which separates the spindle, and the button drops into the box F beneath; another is put in, and held fast to be turned round the moment the handle *g* is released. Some horn buttons have shanks, which are put in before they are pressed, by children, who drill a small hole in the horn, and insert the shank. The mould has, of course, a cavity to receive the shank; and the pressing closes the horn about it so effectually, that it will not come out. The manner of making these shanks will be soon described. Other buttons, called sailors' buttons, have in place of shanks, four holes drilled through them, by presenting them to a lathe, the upper part of which is shewn, Plate CVII. Fig. 8. It has four parallel spindles *a*, *a*, *a*, *a*, all turning together by the same foot-wheel, by means of two straps *e*, *f*, each of which turns two spindles. At the end of the four spindles is a hook, uniting them with four other spindles *b*, *b*, which are supported by passing through holes in a metal standard A; and their points projecting beyond this, are formed into small drills. The spindles A are necessarily placed at some distance asunder, to admit the pulleys for the straps; but the hooks acting as universal joints, allow the ends of the drills *b* to come very near to each other. The button is placed in a concave rest B, and thrust against the drills by a piece of wood. The standard A can be changed for another with more distant holes, to suit larger buttons; and the rest B can be elevated or depressed for the same purpose. The frame and foot-wheel are similar to Fig. 1. The roughness produced by drilling these holes, is removed by shaking a number of buttons in a flannel bag. In horn buttons the pattern is formed by the impression of the moulds; but some plain horn buttons are very prettily ornamented after pressing, by holding over them a thin plate of brass, which has a pattern cut out in it, then rubbing the button with dry emery powder, the face of the button is scratched to a dead colour where the brass plate is cut out, leaving the figure of the pattern in a fine black polished surface. The horn-presser's chips are sold for manure, for almost the same price as the same quantity of the hoofs costs; other chips are used to make hartshorn; and the drill-dust and filings are used by file-makers, in hardening these articles.

Metal buttons are formed of an inferior kind of brass, pewter, and other metallic compositions: the shanks are made of brass or iron wire, the formation of which is a distinct trade. The buttons are made by casting them round the shank. For this purpose, the workman has a pattern of metal, consisting of a great number of circular buttons, connected together in one plane, by very small bars from one to the next; and the pattern contains from four to twelve dozen of buttons, of the same size. An impression from this pattern is taken in sand, in the usual manner; and shanks are pressed into the sand in the centre of each impression, the part which is to enter the metal being left projecting above the surface of the sand. The buttons are now cast from a mixture of brass and tin; sometimes a small proportion of zinc is added, which is found useful in causing the metal to flow freely into the mould, and make a sharp casting. When the buttons are cast, they are cleaned from the sand by brushing; they are then broken asunder, and carried to a second workman at the lathe, who inserts the shank of a button into a chuck of a proper figure, in which it is retained by the back centre of the lathe being pressed against the button with a spring. The circumference is now, by filing it as it turns round, reduced to a true circle; and the button is instantly released, by the workman's holding back the back centre, and is replaced by another. A third workman now turns the back of the button smooth, in a chuck lathe, and makes the projecting part round the shank true; and a fourth renders the face of the button smooth, by placing it in a chuck, and applying the angle of a square bar of steel across its centre. As this tool is used without any rest, much time is saved by the workman not being necessitated to turn the button perfectly flat; as the tool, being only held in the hand, will accommodate itself to a trifling deviation from the truth. The sixth operation is polishing the buttons. The shanks are held in a piece of wood, and the face is rubbed on a board covered with leather, and spread with powder of rotten stone and oil, and afterwards with a finer powder. The last polish is now given by applying the button lightly to the flat surface of a buff or circular board, turned by the lathe; it is covered with soft leather, and dressed with exceedingly fine powder of rottenstone. These polishings are performed by women, and finish the buttons, except that they are to be boiled or rendered white. For this purpose, melted tin is poured into cold water, and by this means granulated. A quantity of cream of tartar, diluted with water, is put into a boiler, and the tin added to it; the boiling causes part of the tin to be dissolved; and the buttons being let down into the liquor upon a wire grating, part of the tin attaches itself to the surface of the buttons, rendering them white, and retaining their former polish. This method of washing with tin is very good, and the wash remains a long time upon the buttons.

Gilt Buttons are stamped out from copper, (having sometimes a small alloy of zinc,) laminated in the flatting mill to the proper thickness. The stamp is urged by a fly-press, which cuts them out at one stroke. These circular pieces, called blanks, are annealed in a furnace, to soften them; and the maker's name, &c. is struck on the back by a stamp, which is a machine very similar to a pile engine. The stamp also renders the face very slightly convex, that the buttons may not stick together in the gilding process.

The shanks are next to be soldered on. For this purpose, each blank is provided with a small spring, similar to a pair of tweezers, which holds a shank down in a proper position upon each; a small quantity of spelter and borax, mixed together with water, is placed round each shank, and ten or twelve dozen in this state are introduced, upon a large iron shovel, or peel, into an oven, heated sufficiently to fuse the solder. When this happens, they are withdrawn from the oven, and while warm are thrown into aquafortis and water (called *pickle*). This raises a black oxide upon the surface of the metal; and in this state the edges of the buttons are turned in the same manner as the metal buttons before described: but as the blanks are sufficiently smooth, it is unnecessary to turn the face or back, and they only require to be *dipped* cold into a second pickle, composed of nitric acid and water, weaker than the former, to remove the black scale. After this, instead of the polishing which metal buttons undergo, they are burnished in the lathe, to render the surface smooth, and close up the pores of the metal previous to gilding. The burnishing is performed by a hard black stone, called blood-stone, fixed into a handle, and applied to the button as it revolves by the motion of the lathe. The blood-stone is of the class hæmatites, a peculiar species of iron ore. It is found occasionally in the gravel and alluvial mixtures on the surface of various places in and near Derbyshire, viz. Ashborne, New Haven, Spoonden; at Norris Hill and Ashby Wolds in Leicestershire; in the dry courses of the underground rivers above Ilam in Staffordshire; and at Boythorp in Nottinghamshire.

A great number of the buttons, thus prepared for gilding, are put into an earthen pan, with the proper quantity of gold to cover them,* amalgamated with mercury in the following manner: The gold is put into an iron ladle, and a small quantity of mercury added to it; the ladle is held over the fire, till the gold and mercury are perfectly united. This amalgam being put into the pan with the buttons, as much aqua fortis, diluted with water, as will wet them all over is thrown in, and they are stirred up with a brush, till the acid, by its affinity to the copper, carries the amalgam to every part of its surface, covering it with the appearance of silver. When this is perfected, the acid is washed away with clean water. This process is by the workmen called quicking.

The silvered buttons are now put into a large frying-pan, which is placed on a fire, and is continually shaken, to heat them equably; which soon occasions the mercury to appear as if melting. When this appearance takes place, the buttons are put into a cap made of felt, like a large cap without a brim, and are stirred about with a brush, to spread the gold contained in the mercury equally over all the surface, while the latter is so hot as to be nearly volatile. The buttons are now returned to the pan, and the heat causes the mercury to fly off in vapour; the buttons beginning to turn yellow, from the gold discovering itself as the mercury *dries off*. The buttons are a second time worked in the cap during the process, and returned to the pan to complete them. Sometimes they will not dry off completely in the pan, small spots remaining white on the buttons; but these are removed by putting the buttons into a cylindrical copper box with a lid, which is laid on a small charcoal fire, and turned round by a pair of tongs, to heat all parts equally. When taken from this box, the gilding is finished, the buttons being of a fine yellow colour, but without any polish. This is given by burnishing them in a lathe, the spindle of which revolves with an immense velocity. A button is slipped into a chuck which exactly fits it; a blood-stone fixed in a handle like a glazier's diamond, is dipped in water, and being applied to the button as it revolves, brings it to a polish in an instant. The button does not fit the chuck so accurately as to prevent it from slipping out by the action of the burnisher, if the workman did not apply his forefinger to the opposite side of the button, to keep it in. He has a piece of soft leather sewed round his finger, to obviate the effects of the friction; and this leather being wetted with water, prevents the blood-stone from attracting the gold, as it would otherwise do. A second finer blood-stone is next applied, and this finishes them. When the workman removes his finger, the button drops out of the chuck; but if it is not perfectly burnished, he can return it in an instant without stopping the lathe. The buttons pass through the hands of three workmen to burnish them: The first burnishes the back; the next burnishes the edge, for which purpose his lathe has a chuck something like a vice, which receives the shank; and he is obliged to stop the lathe every time before he puts in the button. The third workman polishes the face, in the manner above described, which finishes them, if they are plain gilt buttons.

Some of these buttons are afterwards ornamented with concentric circles, of an appropriate pattern, described on the face. This is done in the lathe, by applying a milling tool. The milling tool is a small steel roller, having the intended pattern engraved on its periphery. It is held in a simple slide rest, which makes the circles on the next button that is done of the same size as those of the preceding one. Some gilt buttons are ornamented by milling on the edge, which is done in the same way, and by a similar machine to that which is used for milling the edge of coins. *Double gilt* buttons are gilt twice over, in the manner before described.

The process of gilding buttons, or the drying off, is exceedingly pernicious to the operator, as he inhales the vapour of the mercury, which is well known to be a violent poison. In order to obviate this, the following apparatus, Plate CVII. Fig. 9, has been employed with success, by Mr Mark Sanders, an eminent button-manufacturer at Birmingham, for drying off buttons, and at the same time preserving the mercury evaporated in the process. It is thus described in the *Philosophical Magazine*, vol. ix.: A hearth or fire-place, of the usual height, is to be erected; in the middle of which, a capacity for the fire is to be made: but instead of permitting the smoke to ascend into the top A, made of sheet or cast iron, through which the mercury is volatilised, a flue for that purpose should be conducted backwards to the chimney B. An iron plate, thick enough to contain heat sufficient to volatilise the mercury, is to cover the fire-place at the top of the hearth C. There must be an ash-hole D under the fire-place. The dark square space E. seen in the fire-place, is the flue which serves to carry the smoke back under the hearth into the chimney B. The door of the fire-place, and ash-pit, may either be in front or at the end of the hearth at F, which will perhaps less incommode the work people. The space between A, and the iron plate C, is covered up with a glass window, coming down so low as only to leave sufficient room for moving the pan backwards and forwards with facility. If the sides were also glass instead of brick-work, it would be still better; as the work people would be able to have a full view of their work, without being exposed to the fumes of the mercury, which, when volatilised by heat communicated to the pan by the heated iron plate over the fire-place, ascends into the top A, appropriated for its reception, and descends into the tub G, covered at top, and filled pretty high with water. By this means, the hearth would in fact become a distilling apparatus for condensing and recovering the volatilised mercury. In the tub G, the principal part would be recovered; for, of what may still pass on, a part would be condensed in ascending the tube H, and fall back, while the remainder would be effectually caught in the tube or cask I, open at the top and partly filled with water. The latter tub should be on the outside of the building, and the descending branch of the tube H should go down into it at least 18 inches, but not into the water. The chimney or ash-pit should be furnished with a damper to regulate the heat of the fire.

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* By act of parliament, five grains of gold are allotted for the purpose of gilding 144 buttons; though they may be tolerably well gilt by half of that quantity. In this last case, the thickness would be about the 214,000th part of an inch. See Dr Thomas Young's *Natural Philosophy*, vol. ii. p. 378. Ed.

The water may be occasionally drawn out of the tube by a siphon; and the mercury, clogged with heterogeneous matter, may be triturated in a piece of flannel till it passes through, or placed in a pan of sheet iron, like a dripping pan, in a sufficient degree of heat, and having such an inclination, that the mercury, as it gets warm, may run down and unite in the lower part of the pan. But the mercury will be most effectually recovered, by exposing the residuum left in the flannel bag to distillation, in a retort made of iron or earthen ware.

Plated buttons are stamped by the fly-press, out of copper plate, covered on one side with silver, at the flatting mill. The copper side is placed upwards in stamping, and the die or hole through which they are stamped, is rather chamfered at its edge, to make the silver turn over the edge of the button. The backs are stamped in the same manner as the gilt buttons. The shanks are soldered on with silver solder, and heated one by one in the flame of a lamp, with a blow-pipe, urged by bellows. The edges are now filed smooth in the lathe, care being taken not to remove any of the silver which is turned over the edge. They are next *dipped* in acid to clean the backs, and *boiled* in cream of tartar and silver, to whiten the backs; after which, they are burnished, the backs being first brushed clean by a brush held against them as they revolve in the lathe. The mode of burnishing is the same as for gilt buttons.

Cup buttons, either plated or gilt, are made of two pieces, viz. a common flat button with a shank, and a small hemisphere fixed on in front. These hemispheres are punched out by the fly-press, and then the inside is turned in a chuck lathe, to receive the edge of the plain button, made as before described. When put in its place, the edge of the cup is burnished down over it to hold it fast. These buttons are afterwards gilt and burnished in the same manner as plain ones. Buttons with a hoop or projecting ring round their edge, are done in the same manner.

Button shanks are made from brass or iron wire, bent and cut by the following means: The wire is lapped spirally round a piece of steel bar A, Plate CVII. Fig. 8. the section of which is shewn at *a*. The steel is turned round by screwing it into the end of the spindle of a lathe, and the wire by this means lapped close round it, till it is covered from one end to the other. The coil of wire B, thus formed, is slipped off, and a wire-fork C put into it. It is now laid upon an anvil, and by a punch the coil of wire is struck down between the two branches of the fork C, so as to be in the state of D. The punch has an edge which marks the middle *d*, and the coil being cut open by a pair of sheers along this mark, divides each turn of the coil into two perfect button shanks. This method is so simple and expeditious, that an improvement can scarcely be conceived; but an ingenious mechanic at Birmingham, has lately invented a most curious machine to supersede this part of the labour. This machine, by the simple operation of turning a winch, supplies itself with wire from a reel, and delivers it cut and bent to the proper figure of the shank. Each turn of the winch forms a shank, and the motion is so easy that a boy can drive one machine. The inventor has a very small steam engine, which works several machines in the same room, producing shanks in immense quantities, at an inconsiderable expence in addition to the value of the metal. To attempt any description of this ingenious but complicated little machine, would be ineffectual, without numerous figures; and to give such drawings, would be altogether impossible in a work so limited as ours. See *Encyclopedie Methodique*, Art. *Boutonnier*, for an account of the French method of making button moulds. An account of Clay's patent buttons will be found in the *Repertory of Arts*, vol. xii. p. 241; and an account of Barnett's patent buttons, in the same work, vol xiii. p. 368. (J. F.)

BUXBAUMIA, a genus of plants of the class Cryptogamia, and order Musci. See CRYPTOGAMIA.

BUXTON, a village in Derbyshire, much celebrated for its mineral waters, lies in a barren valley, surrounded with bleak and uncultivated mountains, about thirty-two miles north of Derby. In describing the approach to this place, a modern writer remarks: "All before us appeared the most forlorn nakedness; and had we not observed some marks of human industry in the stone divisions of the fields, we should have conceived that the country round was one wide extent of hopeless sterility." The handsome appearance of the town, however, and the comfortable accommodations of its inns, in some measure repay its visitors for the dreariness of its vicinity. A magnificent range of buildings, in the form of a crescent, has been erected within the last thirty years by the Duke of Devonshire, solely for the reception of the company who resort every season to the wells. It contains three elegant hotels, and some private lodging houses; and in the front is a beautiful colonnade, which is seven feet wide within the pillars, and eleven feet high. This edifice was designed and executed under the direction of Mr Carr; and, together with the offices behind, which are likewise remarkably elegant, is said to have cost nearly 120,000*l*. It displays no affected ornament, but is finished in a style of elegant simplicity. Besides the crescent, there is another building called the *Hall*, which was erected in the 16th century by the Earl of Shrewsbury, for the accommodation of visitants, but which was rebuilt and enlarged in 1670 by the Earl of Devonshire. It contains the baths, and is also one of the principal hotels for the reception of company. The baths are five in number; the gentlemen's bath, the ladies bath, one for the poor, and two private baths. The water is generally drank at St Ann's well, an elegent little building in the antique style, opposite to the crescent, where it is conveyed from the original spring into a white marble bason. This well is regarded as one of the seven[*] wonders of the Peak, from the circumstance that hot and cold spring water may be obtained within twelve inches of each other.

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[*] The other six wonders are, Poole's Hole, the Ebbing and Flowing Well, Elden Hole, Mam Torr, or the Shivering Mountain, the Peak Cavern, and Chatsworth. See DERBYSHIRE.

Buxton has a small manufacture of cotton, but its chief support arises from the visits of strangers, who are annually attracted by the benefit of its waters, or the curiosities of the adjacent country. During the bathing season, which commences in June, and generally concludes in October, the amusements of Buxton consist in assemblies and plays, of which there are three every week; and for the diversion of gentlemen a pack of harriers are kept by subscription.

The warm springs of Buxton were known to the Romans, as appears from several ancient roads concentrating at this spot, and also from the remains of an ancient bath, which was discovered here in 1781, and other specimens of Roman architecture; and they are supposed by Dr Gale to be the *Aquis* of Ravennas. They seem, however, to have been entirely deserted during the middle ages; and it was not until the sixteenth century that they were again brought into notice, by Dr Jones, who in 1572 published a treatise on their beneficial qualities, entitled, "*The Benefit of the Ancient Bathes of Buckstones, which cureth most grievous Sickness.*" Since that time their celebrity has continued to increase, and they have been found very beneficial in various diseases, particularly in gout, rheumatism, nephritic and bilious disorders, and debility of the stomach and intestines. The springs yield a most plentiful supply of water, and have been calculated to throw up about sixty gallons in a minute. The water is used both externally and internally by invalids, and is also employed in the principal hotels for making tea, and other common purposes. When drank, however, in considerable quantities, it is apt to occasion feverish symptoms, and is found to possess a binding and heating quality. Dr Denman recommends it to be taken in moderate portions; and observes, that, "in common, two glasses, each of the size of the third part of a pint, are as much as ought to be drank before breakfast, at the distance of forty minutes between each; and one or two of the same glasses between breakfast and dinner will be quite sufficient." In the baths the water rises through the crevices of the floor, and its temperature is almost invariably at 82° of Fahrenheit's thermometer; but that which is drank at the well loses about three-fourths of a degree in its passage from the spring to the marble basin. This water is perfectly colourless, and without either taste or smell; and, except its temperature, has scarcely any quality to distinguish it from the purest common springs. According to Dr Pearson's analysis, a gallon of it, when evaporated, deposited 16 grains of sediment, of which $11\frac{1}{2}$ were calcareous earth, $2\frac{1}{2}$ vitriolic selenite, and nearly 2 sea salt; and the same gentleman was the first who ascertained the nature of the air-bubbles which constantly rise with the water and break at the surface, and which he found to consist almost entirely of azotic gas, with a small portion of atmospherical air.

In the neighbourhood of Buxton are immense quantities of lime-stone, of which many hundred tons are annually burnt; and it is worthy of notice, that the habitations of the workmen are scooped out of the small mounts formed of the refuse of the kilns, and appear like a range of caves along the side of the hill. Some of these habitations contain two or three rooms, but few of them have any other light than what they receive by the door and the chimney. "When the workmen," says a modern traveller, "descend into their caves at the time of repast, and a stranger sees the many small columns of smoke issuing out of the earth, he imagines himself in the midst of a village in Lapland."

The village of Buxton contains 180 houses, and 760 inhabitants; and its annual visitors, including their attendants, are supposed to be about 500. See Britton's *Beauties of England and Wales*, vol. iii. p. 437, and Derbyshire. (L)

BUXUS, a genus of plants of the class Monœcia, and order Tetrandria. See Botany, p. 317.

BYE-LAWS, are those orders or private statutes of boroughs and other towns, fraternities of trade, guilds, &c. which regulate their members and common interests. The private regulations of courts-leet and courts-baron in England, are likewise so denominated by some writers; but we can see no reason why the application should stop there, since, in the nature of the thing, it is equally applicable to the private regulations of all courts whatever, even of the highest jurisdiction, and yet the regulations of these courts are not commonly so classed or denominated. The laws of *birlaw*, still known in some districts of Scotland, seem not improperly to be considered as bye-laws, and therefore ranked under the same appellation. They are described by Skene, though with some obscurity, (voce *Burlaw*,) as rules made for the government of a particular neighbourhood, by certain individuals who are chosen for that purpose, by common consent, in the courts called the *byrlaw* courts. The word, he adds, is from the Dutch *baur*, or *baursman*, i. e. *rusticus*; so that bye-laws are *leges rusticorum*.

To be obligatory, bye-laws must, of course, be consistent with the charter or other fundamental principles of the corporation or other body over which they are meant to have effect; they must derogate nothing from the established usages of such particular community; be framed with an impartial regard to the common interest; and be strictly conformable to the public or municipal law of the county. Blackst. *Comm. Tomlins.* Jacob's *Law Dict.* (J. B.)

BYNG. See Britain, Index.

BYRON, the Hon. John, an admiral in the British service, is chiefly known as the author of a "Narrative of the Shipwreck of the Wager on a desolate Island on the coast of Patagonia," and as being the principal actor in that disastrous occasion. He was the second son of William, fourth Lord Byron, and was born on the 8th of Nov. 1723. Having entered the navy at a very early age, he was appointed a midshipman when only eight years old, in 1731, before which time, however, he had made several voyages in a merchantman. In the expedition which was dispatched against the Spanish settlements in South America, under Commodore Anson, and which sailed from Portsmouth on the 18th of September 1740, Mr Byron was a lieutenant on board the Wager. The result of this expedition is sufficiently known, from the classical account of it which was given to the world under the direction of its commander. After doubling Cape Horne, with considerable difficulty, the Wager became so disabled in her rigging, that she was unable to keep company, and was at last completely separated from her consorts in the Pacific Ocean. During a violent storm which ensued, the crew were exposed to all the apprehensions arising from the dangers of a lee shore, and as all endeavours to wear the ship off the land had proved fruitless, every ray of hope was extinguished in the awful night which succeeded. It came on dreadful beyond description, and early in the morning the ship struck. "In this dreadful situation," says Mr Byron, "she lay for some little time, every soul on board looking upon the present minute as his last, for there was nothing to be seen but breakers all around us." From this perilous extremity, however, they were relieved by a mountainous sea which hove the ship off; and soon after she most providentially stuck fast between two rocks, when the day breaking, and the weather clearing up, the crew got safely on shore. This miraculous deliverance from immediate destruction, though in such circumstances a most desirable event, and the highest object of their wishes, was to many of them only a prolongation of misery. "Whichever way we looked," observes our author, "a scene of horror presented itself; on one side the wreck, (in which was all that we had in the world to support and subsist us,) together with a boisterous sea, presented us with a most dreary prospect; on the other, the land did not wear a much more favourable appearance: desolate and barren, without sign of culture, we could hope to receive little other benefit from it, than the preservation it afforded us from the sea." But for the consequent sufferings, and interesting adventures of Mr Byron, during nearly five years, we must refer to his "Narrative;" we cannot, however, refrain from presenting to our readers the sum of them, in the beautiful lines of Mr Campbell in his address to Hope:

"Friend of the brave! in peril's darkest hour,
Intrepid virtue looks to thee for power;
To thee the heart its trembling homage yields,
On stormy floods, and carnage cover'd fields.

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—— such thy strength-inspiring aid that bore
The hardy Byron to his native shore:—
In horrid climes, where Chiloe's tempests sweep
Tumultuous murmurs o'er the troubled deep,
'Twas his to mourn misfortune's rudest shock,
Scourg'd by the winds, and cradled on the rock:
To wake each joyless morn, and search again
The famish'd haunts of solitary men,
Whose race, unyielding as their native storm,
Knows not a trace of nature but the form;
Yet, at thy call, the hardy tar pursued,
Pale, but intrepid; sad, but unsubdued;
Pierc'd the deep woods; and, hailing from afar
The moon's pale planet, and the northern star,
Paus'd at each dreary cry, unheard before,
Hyænas in the wild, and mermaids on the shore;
Till, led by thee o'er many a cliff sublime,
He found a warmer world, a milder clime,
A home to rest, a shelter to defend,
Peace and repose, a Briton, and a friend.*

Pleasures of Hope.

On his return to England in 1746, Mr Byron was appointed to the Syren frigate, which he continued to command during the remainder of the war. Ill fortune, however, seemed still to attend him. Every cruize was unfruitful. "His courage and conduct were undoubted," says his biographer, "but he was ever a day too soon or a day too late;—or he sprung a mast in chase, or lost his prize in a fog; or fell in with a wane of wind, which his enemy had passed, or some disaster or other." So invariable, indeed, was his ill luck, and so frequent his misadventures, that he was emphatically called, by his nautical brethren, "Foulweather Jack."

At the peace in 1750, Captain Byron went with Commodore Buckle to the coast of Guinea; and in 1757 he commanded the America of 60 guns, in the luckless expedition against Rochfort, under Sir Edward Hawke. In 1760, however, when stationed off the coast of America with the British fleet under Lord Colville, his fortune began to brighten, and he here found an opportunity of being of some service to his country. The Admiral, having received intelligence that a French squadron, with troops and stores on board, had put into Chaleur Bay, in the Gulf of St Lawrence, dispatched Captain Byron in quest of them, with the Fame a 74, which he then commanded, together with the Repulse and Scarborough. After experiencing some difficulty in approaching them, on account of their being so high in the bay, he completely accomplished his object, by destroying the whole squadron, consisting of three frigates, besides 20 schooners, sloops, and small privateers.

Captain Byron was equally fortunate in a voyage of discovery, which was undertaken at the desire of his majesty, in order to ascertain whether there were any islands lying in the Pacific Ocean, between the southern tropic and the equator. He sailed in the Dolphin of 24 guns, which was completely fitted up for the occasion, in the beginning of July 1764, having in company the Tamer sloop of war, commanded by Captain Mouatt; and it was the discoveries which he accomplished in this voyage, which led to the dispatch of Captains Wallis and Carteret shortly afterwards to the same hemisphere. In the account of this expedition, the existence of a race of men, of a stature very superior to the common standard, on the coast of Patagonia, is stated with great confidence; and has given rise to much doubt and discussion. "One of them," says the Commodore, "who afterwards appeared to be a chief, was of a gigantic stature, and seemed to realize the tales of monsters in a human shape: he had the skin of some wild beast thrown over his shoulders, as a Scotch Highlander wears his plaid, and was painted so as to make the most hideous appearance I ever beheld: round one eye was a large circle of white, a circle of black surrounded the other, and the rest of his face was streaked with paint of different colours: I did not measure him; but if I may judge of his height by the proportion of his stature to my own, it could not be much less than seven feet." But we must defer entering upon this controversy at present, and must refer for a particular account of this people to the article PATAGONIA. Commodore Byron returned to England in 1766, and in 1769 was appointed to the government of Newfoundland, which he held till 1775. In that year, having risen through the successive ranks of admiral of the blue, the white, and the red, he was dispatched with a squadron to America, to oppose the French fleet under Count d'Estaign. Here, however, his evil genius attended him. His fleet was dispersed in a storm; and even after he had reached the object of his destination, he was unable to effect any thing decisive, owing to his being encumbered with a fleet of transports, and the superior sailing of the enemy. Disgusted with his ill fortune, he resigned his station, leaving the command with Rear-admiral Parker; and, retiring from the service, he never would accept of any other appointment. He was, however, raised to the rank of vice-admiral of the white in 1779, and died, at the age of 73, on the 10th of April 1786.

Admiral Byron was an officer of the first talents and respectability; and though his exertions often failed of their merited success, their failure was never attributed either to his want of skill, bravery, or perseverance. He served his country with undaunted courage in every quarter of the world for 45 years; and, during that time, was much beloved and esteemed for the inestimable qualities of his heart, and his kindness and humanity to those whom he commanded. See Ballantyne's edition of *Byron's Narrative*, containing a well written life of the author, to which we have been indebted for the principal facts in this article. (*p*)

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* This friend was Don Patricio Gedd, a Scotch physician, resident at St Jago, the capital of Chili. See the "Narrative," page 161.

BYSSUS, a genus of plants of the class Cryptogamia, and order Alga. See CRYPTOGAMIA.

BYSSUS, or BYSSUM, the name of a fibrous substance produced in Egypt, India, Judea, and at Elis, and employed by the ancients in the formation of fine garments.

Some writers suppose that the byssus of the ancients was the silken threads of the pinna marina. Bochart imagines that it was a kind of fine flax, while others consider it to be a cotton, or a mixture of linen and cotton. See Foster *de Bysso Antiquorum*, Lond. 1776; Osbeck's *Voyage to China*, vol. i. p. 383; and *Mem. Acad. Par.* 1712. p. 204. See also COTTON. (*w*)

BYSTROPOGON, a genus of plants of the class Didynamia, and order Gymnospermia. See BOTANY, p. 236.

BYZANTIUM, an ancient city of Thrace, situated on the Bosphorus, N. Lat. 41°, E. Long. 29°. It stood on a promontory of a nearly triangular form, commanding, to the right, a view of the Propontis, or sea of Marmora; in front, the narrow channel of the Bosphorus, with the cities of Chalcedon and Chrysopolis, on the Asiatic coast; and to the left, fertile eminences, and a gulf, which retreating inland not less than six English miles, served for a most commodious harbour. The river Lycus, formed by the conflux of two small streams, fell into it, and this harbour was altogether so excellent, that it is at this day, according to some, called the Porte, by way of eminence;* and was universally considered as combining more of the advantages of strength, convenience, and beauty, than any other harbour in the world. So much was this the case, that the inhabitants of Chalcedon, on the Asiatic side of the strait, were denominated by the oracle *the blind*, *caeci*, (Tacit. *An.* b. xii. c. 63.) because their founders had, a short time before the building of Byzantium, (when they had their choice of the two sides,) been so stupid or blind as to prefer the Asiatic. The harbour, at its mouth, was only about 500 yards broad, but in most other places a mile, and capable of floating vessels of any size.

Byzantium occupied the place where the capital of the eastern empire afterwards stood, and where the capital of the Turkish empire now stands. About seven miles to the north of the city, viz. at the place where stood the celebrated temple of Mercury, and where Darius connected the two continents by a bridge of boats, the channel of the Bosphorus was so narrow, that two persons, placed the one in Europe and the other in Asia, could easily make themselves heard by one another. The citadel stood on the point of the promontory. The walls of the city were built of huge square stones, so skilfully jointed as to have only the appearance of a single block, and they were much loftier on the land side than towards the water, where the waves and projecting rocks formed a natural defence. They were strengthened by numerous towers, seven of which are said to have been so artfully constructed, that the least noise made in any one of them was immediately communicated to all the rest. Ancient authors inform us, that, in the fourth century before the Christian æra, this city had a gymnasium, as well as many other public buildings, and possessed almost every convenience and luxury which we usually find among a rich, numerous, and active people. Xenophon says, they had a forum spacious enough to contain a small army drawn up in order of battle, and in this forum, Demosthenes says, the people used to assemble to confirm or reject the decrees of their senate.

A considerable territory belonged to Byzantium, which was abundantly productive of grain and fruits. Aristæus, Pliny, and Tacitus, inform us, that immense quantities of fish, (though of what kind they do not say,) were wont to be caught in the harbour. *Vis piscium innumera*, says the latter, *Ponto erumpens, et obliquis subter undas saxis exterrita, omisso alterius littoris flexu, hos ad portus defertur.*† Spring and autumn were the principal seasons for taking these fish. In spring they were proceeding northward into the colder regions of the Euxine Sea, and in autumn returning southward into the Mediterranean. This fishery, according to Aristæus, brought a large revenue to the city, which likewise enjoyed an active and flourishing commerce. The excellence of its harbour, sheltered on every side from storms, attracted thither numerous vessels from all the nations of Greece; and its situation at the mouth of the strait enabled it to subject to heavy duties, or to stop altogether, those merchants of more southern states who carried on a trade with the Euxine. Hence the importance attached to the friendship of this city by the Athenians and Lacedæmonians, and their constant endeavours to engage it in their interests.

It was founded according to Eusebius, about the 30th Olympiad, that is 656 years before the birth of Christ, during the reign of the Roman king Tullus Hostilius; but, according to Diodorus Siculus, the foundations of Byzantium were laid as far back as the Argonautic expedition, 1250 years before the Christian era. The founder, he says, was one Byzas, a king of the neighbouring country, from whom Byzantium derived its name. Eustathius says, that this Byzas came into Greece, and settled there with a colony of Megaræans, a short time before the Argonauts arrived in those seas. Velleius Paterculus supposes Byzantium to have been founded by the Milesians, and Ammianus Marcellinus ascribes it to the Atticans. *Vetus Byzantium Atticorum colonia*, says he. Probably the Milesians were a colony of Atticans; and if so, Velleius and Ammianus are perfectly reconciled. But it is probable that these last mentioned people only rebuilt or repaired Byzantium, after it had been destroyed or had fallen into decay. Medals of ancient Byzantium have reached our times, bearing the name and head of Byzas, with the prow of a ship on the reverse.

Justin says, that Pausanias the Spartan first built Byzantium, but in this he must have been mistaken; for we learn from Thucydides and Herodotus, that Pausanias, about the year B. C. 476, took it from the Persians, who had made themselves masters of it, before he had been in that quarter. Pausanias probably rebuilt and improved Byzantium while he continued to possess it, and while he there carried on his treacherous correspondence with the Persians.

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* Others, however, give a different account. "The offices of all the Viziers are in the same court or division of the palace; the entrance of which is through a lofty gate-way, called the Babi Homayon (imperial gate) translated by Europeans the Sublime Porte." Mirza Abu Taleb's *Travels*, vol. ii. p. 241.

† "The only article in which the markets of Constantinople excel those of other cities is fish; of these they have a great variety, some of which are very delicious." *Travels of* Mirza Abu Taleb Khan, vol. ii. p. 226.

The city underwent many revolutions and frequently changed masters, having been sometimes in the possession of the Persians, sometimes of the Lacedæmonians, and also of the Athenians, who took it about the year B. C. 407. In the year B. C. 339, it was attacked by Philip of Macedon, who, after a tedious siege, was compelled by Phocion, the Athenian general, to relinquish his object and retreat.

The whole of Greece, together with Lycia, Rhodes, Samos, Cilicia, Thrace, and Byzantium, after many vicissitudes, was, in A. D. 71, reduced to the state of Roman provinces by Vespasian.

The siege of Byzantium, by Severus, which commenced A. D. 194, and continued for three years, was, both for the obstinacy of the defence, and the cruelty exercised by the conquerors after its capture, one of the most extraordinary recorded in history. Having taken part with Niger, in the contest betwixt him and Severus, the latter invested it in due form. But though during the siege, the bloody battle of Issus was fought, which terminated in the defeat and death of Niger, and though his head, when sent to Byzantium, was exhibited to the besieged on the point of a spear, yet the city still held out.

In addition to the natural advantages and strength of the place, the Byzantines had, both before and during the siege, provided themselves with warlike machines of various sorts; some of which hurled against the besiegers when they approached the walls, large beams and stones, whilst others showered upon them darts and smaller stones to a greater distance. Strong iron hooks fastened to chains were let down from the wall, and dragged up whatever they laid hold of.

One Periscus, a famous Bithynian engineer, is said to have been the constructor of these machines; and was more fortunate after the capture of the city than the celebrated Archimedes of Syracuse; for his life was spared by Severus, who hoped to profit by his talents. The entrance of the harbour was barred by a strong chain, and its piers on each side were fortified by towers. It contained 500 small vessels, of which the greater part had pointed iron prows; and some of them were constructed with a rudder at each end, and had a double complement of men to work them, so that without turning, and at a moment's warning, they could advance or retire as occasion required. When the besieged lost any of their ships, they built others of the timber of their houses, and the women cut off their hair to supply materials for ropes. A very extraordinary stratagem is said to have been employed by them for taking some of the ships of the enemy. Divers, says Dion Cassius, swimming under water, cut the cable of an enemy's ship and drove into her bottom a strong nail fastened to a rope; the other end of the rope being in one of their own ships, they could thus haul off the vessel of the enemy. When their supply of darts and common stones failed, they demolished the walls of their theatres, and hurled the stones of them against the foe.

Famine became so urgent, that they were at length reduced to the necessity of using the most loathsome substances for food, and even human flesh itself. At last, while in this miserable situation, some of the most daring and vigorous took advantage of a storm that arose, to embark on board their ships and bring a supply of food for their fellow citizens, or perish in the attempt. They were, however, attacked by the besiegers on their return, and so completely destroyed that not a single ship escaped. Deprived of their last hope, the Byzantines were compelled to surrender; and the mind contemplates with horror and disgust a people, after a defence so brave and protracted, deprived of their estates and sold for slaves,—their magistrates, commanders, and soldiers, indiscriminately massacred, and the walls of their city levelled with the ground; yet such was the treatment they received from their ungenerous conquerors. Dion Cassius says, he saw their city after its capture "in such a state of ruin, that it might have been thought to have been taken by the barbarians, rather than the Romans." Not long, however, after this terrible catastrophe, Severus himself caused a part of the city to be rebuilt, and changed its name to Antonina in compliment to his son Caracalla, whose proper name was Antoninus. But he did not restore the privileges of a free city, nor reverse the decree by which it had been subjected by him to the dominion of its neighbours, the Perinthians.

In 262, for reasons which have not been very well ascertained, the tyrant Gallienus had determined to wreak his fury on the Byzantines. Despairing of being able to take so strong a place by force, he made the most solemn assurances to the inhabitants, that if they would admit him into their city, all persons and their property should be sacredly respected. But he violated these assurances, and was no sooner admitted than he ordered a general massacre, not only of the garrison, but of the inhabitants at large; and, according to Trebellius Pollio, not an ancient family of Byzantium was left in existence, except a very few, whose members happened at the time to be abroad in the armies or on business.

In the wars betwixt the two emperors Maximin and Licinius, the first besieged and took Byzantium, but was in a short time after compelled to give it up to his rival, who, in his turn, was under the necessity of abandoning it to Constantine the Great, to whom it opened its gates in 324.

Constantine was so strongly impressed with the superior advantages of Byzantium as a place of residence, that he resolved to make it for the future the capital of his empire. Accordingly he began next year to repair, enlarge, and beautify it. Anxious that his successors should follow his example, in making this new city the place of their ordinary residence, he spared neither cost nor pains to render it worthy of their preference. Magnificence, convenience, and beauty, were studied in all its public and private edifices, and in a short time Byzantium was seen almost to rival the ancient capital of the empire. "He urged the progress of the work," says Gibbon, "with the impatience of a lover; the walls, the porticoes, and the principal edifices, were completed in a few years." The encouragement given to settlers in the new city, and particularly an edict published by the emperor, declaring that such as had lands in Thrace, Pontus, or Asia, should not be at liberty to dispose of these, or even leave them to their proper heirs at their death, unless they had a house in the city of Byzantium, soon rendered it one of the most populous and flourishing of the empire. An amphitheatre, a circus maximus, several forums, porticoes, and public baths, with whatever else could contribute to the dignity of a great capital, and to the benefit or pleasure of its numerous inhabitants.

were soon found in Byzantium. The city was divided into 14 regions, and privileges and immunities granted to the inhabitants equal to those that were enjoyed in Rome. The common people even from that ancient capital, as well as from all other parts of the empire, were invited, by the emperor's donations of corn, wine, and oil, to come and settle at Byzantium. Christians, however, had a manifest preference shewn them. The statues of the heathen deities were every where demolished, and their temples converted into churches, and consecrated to the worship of the true God. Crosses were erected in all the squares and public places.

In the 25th year of his reign, (May 11th, 330,) Constantine, if we believe Cedrenus, caused the city to be solemnly dedicated to the Virgin Mary; but Eusebius says, it was consecrated to the God of Martyrs. On this occasion it was dignified with the new name of *Constantinopolis*, the city of Constantine, its great benefactor; and, what was still more flattering, with the name also of *Second*, or *New Rome*, being declared to be the metropolis of the East, as Old Rome was of the West. The emperor established a senate and other magistrates, at Constantinople, equal in power and authority to those of Rome, nor did he ever after return to that ancient capital. The removal of the imperial seat to Byzantium is commonly stated to have taken place in the 25th year of the reign of Constantine, A. D. 330, and A. U. C. 1126. See Stephan. *in voce* Βυζαν. Velleius Pater. *Euseb. Chron. Anc. Un. Hist.* vol. xiii. and xiv. Barthelemy *Voyage de jeune Anachar.* Gibbon's *Rom. Empire*, vol. iii. (*x*)

C.

C. See ALPHABET and CHARACTER.

C, in music, has been applied, since the time of Guido, to mark different notes in the scale, at the distance of an octave from each other, viz. C-*fa-ut*, on the second space of the bass stave; C-*sol-fa-ut*, on the ledger line above the bass stave, or the same below the treble stave or the tenor; or C, cliff-line wherever placed, the third space in the treble, &c. This note is the nominal, or key of one of the natural modes, bearing a sharp or major third, and, in that capacity, was denominated *ut* by Guido, and has since been called *do* by the Italians. In modern times, since the temperament of the musical scale has been attended to, it has been usual to consider C as the key note; and usually, the octave above the tenor cliff C, mentioned above, has been used as the bass or fundamental note, and its pitch, or degree of acuteness, has been regulated and preserved by steel instruments, called tuning-forks, or C-*forks*, used by the tuners of finger-keyed instruments; but violin performers use an A-fork for tuning their instruments, because they have no string to the note C; and some few persons, as Mr Broadwood, use the A-fork for piano-fortes. The pitch, or degree of tone, of the tenor cliff C, in our best concerts, is now such, as to make, or excite in the air, 240 complete vibrations in one second of time, (see CONCERT *Pitch*,) and the C below this, half as many, or 120; the C above it, 480; and that next higher still, 960 vibrations, &c.

CAABA, a stone edifice in the temple of Mecca, which has been revered with superior sanctity by the Arabians, from the remotest antiquity; and to which every Mahometan is required by the Koran to direct himself in prayer.

Among the variety of fabulous traditions which have been propagated by the followers of Mahomet, concerning the origin of this building, we find it asserted, that its existence is coeval with our first parents, and that it was built by Adam, after his expulsion from Paradise, from a representation of the celestial temple, which the Almighty let down from heaven in curtains of light, and placed in Mecca, perpendicular under the original. To this the patriarch was commanded to turn his face when he prayed, and to compass it by way of devotion, as the angels did the heavenly one. After the destruction of this temple by the deluge, it was rebuilt by Abraham and his son Ishmael on the same spot, and after the same model, according to directions which they received by revelation; and since that time it has continued to be the object of veneration to Ishmael's descendants. Whatever discredit we may give to these, and other ravings of the Moslem impostor concerning the Caaba, its high antiquity cannot be disputed; and the most probable account is, that it was built and used for religious purposes, by some of the early patriarchs; and after the introduction of idols, it came to be appropriated to the reception of the Pagan divinities. Diodorus Siculus,* in his description of the coast of the Red Sea, mentions this temple as being, in his time, held in great veneration by all the Arabians; and Pococke† informs us, that the linen or silken veil, with which it is covered, was first offered by a pious king of the Hamyarites, seven hundred years before the time of Mahomet. It had been frequently repaired, and was rebuilt a few years after the birth of this prophet, by the tribe of Koreish, who had acquired the possession of it either by fraud or violence from the Khozaites. The Caaba then contained three hundred and sixty images of men, lions, eagles, &c. the objects of idolatrous worship, which were all destroyed by Mahomet, after the taking of Mecca, when it was purified and adorned, and consecrated to the service of Islam. It received several reparations after his death, and was rebuilt by one of his successors, with some alterations, in the form in which it now stands.

As no European is permitted to visit Mecca, the only knowledge we have of the present appearance of the Caaba, is derived from the descriptions and draughts of the Mahometans, who indeed speak of it in terms of high admiration. It would appear, however, even from their designs, that it is an aukward and shapeless building. It consists of a sort of square tower, 24 cubits by 23, and 27 high, covered on the top with rich black damask, bordered with an embroidery of gold, which was formerly renewed every year by the Mahometan Caliphs, afterwards by the sultans of Egypt, and which is now annually provided by the Ottoman Porte. The floor is raised six feet from the ground; and a door and window admit the light. Its double roof is supported by three octagonal pillars of aloes wood, between which are suspended several silver lamps; and the gutters on the top are made of pure gold. At a small distance from this tower, on the east side, is the *station* of Abraham, where is a stone upon which the patriarch is supposed to have stood when he built the Caaba, and which, they pretend, still bears the traces of his footsteps. It is inclosed in an iron chest; and here the sect of Al Shafei meet for religious purposes. On the north of the Caaba is the *white stone* within a semicircular enclosure, 50 cubits long, which is said to be the sepulchre of Ishmael, and which receives the rain-water that falls from the Caaba by a golden spout. This stone is of considerable antiquity, and was even held in great veneration by the Pagan Arabs. Towards the south-east is the well Zem-zem, remarkable for the excellence and medicinal quality of its waters, as well as for its miraculous origin. It is affirmed to be the same spring, which, miraculously bursting out of the ground, supplied Ishmael and his mother Hagar, when overcome with thirst in the wilderness of Beersheba; and is celebrated by the Mahometans, not only for curing many bodily diseases, but also, if taken copiously, for healing all spiritual disorders, and procuring an absolute remission of sins. The well is protected by a dome or cupola, and its water is drank with much devotion by the pilgrims, and conveyed in bottles to the most distant quarters of the Mahometan dominions. But the most singular relic, and which is regarded with extreme veneration, is the famous black stone, which the Mahometans pretend was one of the precious stones of Paradise, and was brought down from heaven by the angel Gabriel. According to the received tradition, derived from Mahomet himself, it was originally of such a bright white colour as to dazzle the eyes at the distance of four days journey, but that it wept so long and so abundantly for the sins of mankind, that it became at length opaque, and at last absolutely black. When the Carmathians took Mecca, they pillaged the Caaba, and carried off the black stone in triumph to their capital. The Meccans made every effort to recover it, both by entreaties and the offer of 5000 pieces of gold, but without effect. The Carmathians, however, after having kept it 22 years, sent it back of their own accord. It is now set in silver, and fixed in the south-east corner of the Caaba, looking towards Basra, about 3½ feet from the ground. It is called by the Mahometans "the right hand of God," and is kissed by the pilgrims with great devotion.

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* Ιερον αγιωτατον ιδρυται τιμωμενον ὑπο παντων Αραβων περιττοτερον. tom. i. p. 211.

† Specimen, p. 60, 61.

The Caaba is almost surrounded with a circular inclosure of pillars, connected at the top by bars of silver, and towards the bottom by a low ballustrade. Without this enclosure, on the south, north, and west, are three oratories, where three of the Mahometan sects assemble to perform their devotions. The whole is enclosed at a considerable distance by a square colonnade, or great piazza, covered with small cupolas, and consisting of 448 pillars, from which hang numerous lamps, and 38 gates; and from each corner rises a minaret or steeple, adorned with a gilded spire and crescent. This enclosure was built by the caliph Omar, to prevent the court of the Caaba from being encroached upon by private buildings. It was at first merely a low wall, but has since been raised by the liberality of succeeding princes to its present magnificent state. The whole structure of the Caaba is in a peculiar manner styled Al Masjad Al Haram, "the sacred or inviolable place;" which appellation, however, is sometimes extended to the whole territory of Mecca.

According to the command of Mahomet, every Mussulman must, once in his life, visit the Caaba, and perform the customary acts of devotion in the sacred places. But could the prophet have foreseen into what distant regions his religion was to be introduced by the arms of his followers, he would soon have perceived the absurdity of such an injunction. Few, in comparison with the immense numbers who have embraced the doctrines of Islam, can be supposed able to discharge this duty; and we may presume, that it is only such as are more than ordinarily devout that are ever induced to visit the Caaba from religious motives. Many pilgrims, however, annually resort to the city of Mecca, but commercial ideas mingle with those of devotion; and the arcades of the temple are often filled with the richest merchandize from every quarter of the world. This duty may be discharged by proxy, but the pilgrim, in this character, can act only for one person at one time; and to prevent all imposture, he must carry back with him a certificate from the Imam of Mecca, of his having actually performed all the devotional exercises or ceremonies appointed by the law, in the name of his principal. These ceremonies consist chiefly in performing seven circuits round the Caaba, and kissing the black stone; in running seven times between the mountains of Safa and Al Merwa; in making the station on Mount Arafat; in sacrificing the victims in the valley of Mina; and in burying their hair and nails in the consecrated ground. The same ceremonies were observed by the Pagan Arabs many years before the appearance of Mahomet, but they were confirmed by the command of the prophet, with this alteration, that his followers should be clothed when they compassed the Caaba, whereas their ancestors performed their devotion naked. See Arabia, vol. ii. p. 252; see also Niebuhr's *Travels through Arabia*, vol. ii. p. 26; Gibbon's *Rome*, vol. ix. p. 216, 12mo.; *Mod. Un. Hist.* vol. i. p. 207; Reland *de Religione Mahommedica*, p. 113; and Sale's *Koran*, p. 114. (*p*)

CABAL Ministry. See Britain, p. 584.

CABALLERIA, a genus of plants of the class Polygamia, and order Diœcia. See Botany, p. 341.

CABBALA, among the Jews, means those oral traditions respecting the interpretation of the law, which they pretend were originally communicated by revelation, and handed down from father to son, without interruption, alteration, or omission. By means of this mystical science, they pretended to be able to explain all the appearances of nature, as well as the revealed and written law of God. It appears, indeed, that the Jews preferred the cabbalistical traditions to the acknowledged scriptures, whose meaning they had almost entirely subverted. It was not without reason that our Lord charged the Jews with having made the law of God of no effect by their traditions; and he specifies several instances, which already substantiate the charge.

Maimonides, in the preface to the Mishnah, gives the following account of the origin of the Cabbala. It was revealed to Adam by an angel, who brought him a book containing the mysteries of this recondite science. This book was lost at the fall, and restored again in consequence of the earnest prayers of Adam; and being again lost amidst the corruption which preceded the flood, it was afterwards restored to Abraham. But a particular revelation was given on this subject to Moses, on Mount Sinai, who received a mystical and traditionary, as well as a written and perceptive law. This traditionary law was considered as containing the complete explanation of that which was written; and as the meaning is always more valuable than the mere symbol, so this pretended explanation of the law by divine authority, was soon exalted above the law itself. We are farther told, that Moses, on coming down from the mount, rehearsed both the law and the explanation of it to Aaron; then to his sons Eleazar and Ithamar; then to the seventy elders; and, last of all, to the whole people: so that Aaron heard it four times, his sons thrice, the elders twice, and the people once. The law only was committed to writing; the explanation was entrusted to the memories of the priests and elders. The first was simply called the law, the second the oral law, or cabbala, derived from the Hebrew *kibel*, to receive by tradition. The Jews farther pretend, that the cabbala being again lost during the Babylonish captivity, was restored to Esdras, and they mention severel famous rabbis by whom it was transmitted to later ages.

It cannot be necessary to attempt a serious refutation of these notions, which are not only totally unsupported by scripture, but contrary to some of its clearest intimations. They betray an evident design to wrest the word of God from the people, and to introduce something resembling the *esoteric* doctrines of the heathen: they are in short a part of that system of priestcraft, which has often exerted such a malignant influence over the knowledge and happiness of men.

Some Christian divines have held opinions bearing a considerable resemblance to the cabbala of the Jews. Thus Parkhurst, in his Hebrew Lexicon, p. 115, 4th edit. says, "It may safely be inferred, that the whole garden was so contrived by infinite wisdom, as to represent and inculcate on the minds of our first parents a plan or system of religious truths, revealed to them by their Creator." This may be called a kind of *natural cabbala*. But the doctrine of traditions has been received in its full extent by the church of Rome, which holds them of equal value with the written word of God. According to the council of Trent, "the truth and discipline of the Catholic church are comprehended both in the sacred books and in the *traditions* which have been received from the mouth of Jesus Christ or of his apostles, and which have been preserved and transmitted to us by an uninterrupted chain and succession."

But the Jewish cabbala was chiefly of that artificial kind, waich drew mystical meanings from particular words or expressions, thus producing significations very different from what the words or expressions seemed naturally to imply. This artificial cabbala was of three kinds: the first, called *gematria*, consisted in interpreting words according to the arithmetical power of the letters which composed them. Thus in the words שילה יבא *Iba Shiloh*, i. e. *Shiloh shall come*, the numerical value of the letters is the same as in the word משיח *Messiah*. The second kind of artificial cabbala was called *notaricon*, and consisted in taking every letter for a word, and thus making an entire sentence out of one word. Thus the first word in the book of Genesis בראשית *Berashit*, contains the initial letters of these words, Bera, Rekio, Aretz, Shemim, Im, Teumut, and may be translated, "he created the firmament, the earth, the heavens, the waters, and the abyss." The third kind was called *themurah*, and was much the same as the modern anagram, which consists in forming new words by the transposition of letters. Thus, from the same word *Berashit*, the cabbalists formed *A-bc-tisri*, i. e. the first day of the month Tisri, and from this accidental coincidence, they inferred, that the world was created at that season of the year, corresponding nearly with our September.

These are sufficient examples of rabbinical trifling, and should be a warning to divines and commentators to avoid occult and fanciful interpretations, and to abide by the plain meaning of the word of God. We do not affirm that there never is any secret meaning contained under the words of scripture: in several places of the book of Revelation, some mystery is evidently concealed under particular names and expressions; but then we are expressly warned of this, and unless when we have such intimation, it is idle to search for secret meanings; and even with regard to those names and expressions, which are confessedly mystical, we have shown the danger and uncertainty of cabbalistical interpretations. See ANTICHRIST. For further particulars respecting the Jewish cabbala, see Calmet's *Dictionary*; Prideaux's *Connect.*; Enfield's *Hist. of Philosophy*, vol. ii. chap. 3. (*g*)

CABENDA, or CABINDA, a sea-port town of Africa in the kingdom of Cacongo, is situated at the mouth of the river Cabenda, on the round point of the bay, which is very convenient for trade, wooding, and watering. The huts are built of reeds and mud, and the natives live chiefly by fishing. See the *Strange Adventures of Andrew Battel*, inserted in Purchas's *Collection of Voyages*, &c. See also ANGOY. (*j*)

CABEZZO, one of the provinces of the kingdom of Angola, lying between the rivers Coanza and Rimba. The country, which is well peopled, abounds with cattle and provisions of different kinds. The Portuguese obtain great quantities of iron from the iron mountains in its neighbourhood. (*j*)

CABIRI, in mythology, the name given to certain deities, worshipped with great solemnity in Lemnos, Thebes, and other parts of Greece; but particularly in Samothracia, which was specially consecrated to their service. The word, according to Varro and Macrobius, signifies *great and powerful deities*, and is probably derived from the Hebrew word *geber*, "to be strong." The names of the Cabirian deities, according to Muaseas, as cited by the scoliast of Apollonius Rhodius, were *Axieros*, or Ceres; *Axiocersa*, or Proserpine; *Axiocersus*, or Pluto; and *Casmillus*, the same with the infernal Mercury.

The Cabirian worship is involved in the greatest mystery and obscurity. Captain Wilford has thrown some light on the subject, which, though it does not remove the difficulties, is useful, in so far as it shows the connection between the mythology of the eastern and that of the western world.

In the *Adhuta-cosa* we find the following legends, which have an obvious relation to the deities worshipped in the mysteries of Samothracia. In *Patala* (or the infernal regions) resides the sovereign queen of the *Nagas* (or large snakes;) she is beautiful, and her name is *Asyoruca*. The servant of Dharma-Raja, or king of justice, is *Cashmala*, who drags the wicked with ropes about their necks, and throws them into hell.

Axieros, the name of one of the Cabirian gods, is obviously derived from *Asyoruca*, or rather from *Asyoru*, or *Asyorus*, which signifies literally, *she whose face is most beautiful*.

Axiocersa is derived from *Asyotcersa*, a word of the same import with the former, and was the sacred name of Proserpine. The word Proserpine is obviously derived from the Sanscrit *Prasarparni*, or *she who is surrounded by large snakes.* Nonnus represents her as surrounded by two enormous snakes, who constantly watched over her. Her consort is Vishnu, who, according to the *Puranas*, rules in the west, and during the greatest part of the night. In this sense, Vishnu is the Dis of the western mythologist, the *black Jupiter* of Statius; for Vishnu is represented as of a black or dark azure complexion. The titles of Dis and Ades appear to be derived from A'di or A'din, one of the names of Vishnu. When Cicero says, *Terrena autem vis omnis atque natura, Diti patri dedicata est*, that is, nature and the powers or energy of the earth are under the direction of Dis, this has no reference to the judge of departed souls, but belongs solely to Vishnu.

Cashmala', or Cashmala's, is obviously the Casmillus of the western mythologists. The appellation of Cabiri, as a title of these gods, is unknown to the Hindoos. But the *Cuveras*, or *Cuberas*, as it is generally pronounced, are a tribe of inferior deities, whose history is given in the Puranas, possessed of immense riches, and who are acquainted with all places under or above ground, abounding with precious metals and gems. In this respect, their functions seem to correspond with the name of Pluto, if we suppose him to have had his name from πλȣτος, *divitiæ.*

There can now be no doubt, that we are to look to the East for the origin of some of the most mysterious rites of the western heathen. At the conclusion of the mysteries of Eleusis, the congregation was dismissed with these words, Κογξ Ομ Παξ; *Conx*, *Om*, *Pax.* These mysterious words were till lately considered as inexplicable: they are now, however, found to be pure Sanscrit, and to be used to this day by the Bramins, at the conclusion of religious ceremonies. They are thus written in the language of the gods, as the Hindoos call the language of their sacred books, *Canscha*, *Om*, *Pacsha.* The first signifies the object of our most ardent desires; the second is the mysterious monosyllable, used both at the beginning and conclusion of a prayer; and the third seems to indicate the termination of the religious rites. It answers to the obsolete Latin word, *vix*, a change, alternation, &c. intimating, that the course of religious observances is accomplished. See *Asiatic Researches*, vol. v.

But though we may perhaps thus trace the Cabirian worship to India, we are still as much in the dark as ever, with regard to its real origin and signification. By some the Cabiri are reckoned eight in number; and Shuckford supposes them to be the eight immediate descendants of Misraim, comprehending his seven sons, and Philistin. Were we to admit this interpretation, we should then be enabled to trace the current of mythology from Egypt eastward to India. But we have, at present, no sufficient authority for such a conclusion. See Shuckford's *Connect.* vol. ii.

Others understand by them the eight persons saved in the ark, and commonly denominated the sacred *ogdoad* of Egypt. See Faber's *Mysteries of the Cabiri.* (*g*)

CABLE. See Rope-making.

CABOT, Sebastian, an eminent navigator, flourished in the beginning of the sixteenth century. His father, John Cabot, merchant and pilot, was by birth a Venetian; but, recommending himself, by his address and enterprise, to the notice of King Henry VII., he came to settle in England, under the patronage of that politic prince. Where Sebastian was born is a subject of dispute between the English and Italians; the former asserting, that he was born at Bristol about the year 1477; while the latter contend, that he was by birth, as well as extraction, a Venetian. One thing is certain, that in the oldest documents, written, it is true, by foreigners, he is constantly spoken of as born at Venice, and only brought to this country when a boy. In the report of the pope's legate, to whom Cabot had given a colloquial narrative of his voyages and discoveries, that navigator himself is made to say, that his father, on a mercantile expedition, had brought him from Venice to London when very young, "having nevertheless some knowledge of letters of humanitie, and of the sphere." Be this, however, as it may, young Sebastian received a thorough education suitable to his intended profession, combining at once a knowledge of mathematics and astronomy with early application to the practice of seamanship. He had already, it is said, made several voyages before the age of seventeen.

The whole world at this time resounded with the discoveries of Columbus, who returned from his first expedition in 1493. The skilful and enterprising of all descriptions, were, as is generally the case, seized with a universal frenzy for discovery, in consequence of his success; and merchants and private citizens staked the whole of their fortunes on the chance of discovering lands abounding with gold and spices. John Cabot, who seems to have been nothing inferior in abilities to his son, representing to King Henry the wealth, conquest, and glory which might accrue to England from a successful voyage of the same kind, that monarch granted letters patent, dated the eleventh year of his reign, 1495, to John Cabot, citizen of Venice, and his three sons, Lewis, Sebastian, and Sancius, for the discovery of new and unknown lands. In this deed, preserved in Hakluyt, the king gives full and free authority, leave and power, to sail to all parts, countries, and seas of the east, of the west, and of the north, under our banners and ensigns, with five ships. All the countries discovered were to be taken possession of in the king's name; but to be settled and governed by Cabot, his sons, and heirs, in quality of vassals, or lieutenants, who were to enjoy a kind of feudal authority over the population and traffic of such regions. They were subjected to the restriction of importing the merchandise of their possessions into the port of Bristol only, where, on paying one-fifth part of the clear profits to the king, they were to be exempted from all other customs and imports whatever.

Whether the Cabots sailed this year is uncertain. But we are informed, on the authority of the pope's legate, that, in 1496, Sebastian undertook a voyage of discovery with two ships. His great object, in common with most navigators of that period, was to find a passage leading to Cathay and the spices of the East; and this passage, he conjectured from his globe, might possibly exist in a north-west direction. In the beginning of summer, he accordingly set sail with his two barks, and boldly standing across the Atlantic, in a north-westerly course, trusting, like Columbus, to the guidance of his sphere and his compass, he came in sight of land much sooner than he expected or desired. Heedless of the great glory which on this occasion he acquired, of being the first navigator who saw the continent of America, he felt excessively mortified, that the passage to the Indies should thus be obstructed. Observing that the country extended towards the north, he continued his voyage in that direction, and coasting along dreary shores, which mortal eyes till then had never surveyed, he anxiously examined the bays and inlets; but still found the land "continent." He continued this search, it is said, as far as 67½ degrees; when discovering that the land turned round to the east, and finding himself surrounded by mountains of ice, in a sea where there was no night, with other circumstances of horror, he felt himself under the necessity of putting about, and retracing the whole of his fruitless course. This resolution, it is said also, was accelerated, by a mutiny of the masters and crews of his ships, who refused to proceed further in these dismal seas. It is likewise added, that on this occasion he sailed south as far as Florida, all along examining the coast, in the hope of finding the desired passage. But this account cannot be true, as in that case he would have fallen in with the island of Baccalos, or Newfoundland, which he discovered afterwards; unless, indeed, we suppose the dates to be inaccurate, and that the whole of this north-west expedition took place after his discovery of that island.

The next voyage of the Cabots, for the same purpose, was in the following year 1497; when a royal licence, dated the 13th of Henry VII., was granted to John Cabot, to take six English ships, each of 200 tons and under, from any haven in the realm, and also as many of the king's subjects for mariners as might willingly accompany him. One ship was fitted out at the king's expence, and the merchants of London added three or four smaller ones. The following particulars of this voyage are taken from the great map of Sebastian, on which they were written in Latin by a hand of those times. The reader will not be displeased to have it from the black-letter translation of Hakluyt.

"In the yere of our Lord 1497, John Cabot, a Venetian, and his sonne Sebastian, (with an English fleet set out from Bristoll,) discovered that land which no man before that time had attempted, on the 24 of June, about five of the clocke early in the morning. This land he called *Prima Vista*, that is to say, First seene, because as I suppose it was that part whereof they had the first sight from sea. That Island which lieth out before the land, he called the Island of St John, upon the occasion as I thinke, because it was discovered upon the day of John the Baptist. The inhabitants of this island use to wear beasts skinnes, and have them in as great estimation as we have our finest garments. In their warres they use bowes, arrowes, pikes, darts, wooden clubs, and slings. The soille is barren in some places, and yieldeth little fruit, but it is fulle of white beares and stagges farre greater than ours. It yieldeth plenty of fish, and those very great, as seales, and those which commonly we call salmons. There are soles also above a yard in length; but especially there is a great abundance of that kinde of fish which the savages call *baccalos*. In the same island also there breed hauks, but they are so very blacke that they are very like to ravens, as also their partridges, and eagles, which are in like sorte blacke."

Three of the wretched natives of this island of Baccalos, now better known by the name of Newfoundland, were carried home by Cabot, and are described by cotemporary writers in terms of great wonderment. The island, called St John's, mentioned in the above narration as lying out before the land, is supposed to have been only a projection of the main island itself.

After this period we hear no more of the elder Cabot, and indeed for twenty years little is related of Sebastian; though it is highly probable that his restless disposition, which he himself describes as "flaming with desire" to do something memorable, did not suffer him to be long on shore. In the eighth year of Henry VIII. we find him in strict coalition with Sir Thomas Pert, then vice-admiral of England, by whose interest he obtained a good ship to prosecute his constant and favourite object, the discovery of a passage to the Indies. Baffled in his attempts in the north and west, he now directed his course to the south, and sailed to the coast of Brasil. Here, however, the courage of Sir Thomas failing, Cabot was obliged to desist from his purpose; and having steered for Hispaniola and Porto Rico, where he trafficked for some time, he returned disappointed and chagrined to England. From England he soon after removed to Spain, at that time the seat of commercial and geographical information, and resided at Seville; at once perfecting himself in the knowledge of the globe, and communicating the particulars of his own observation. Here he is said to have met with great encouragement, being appointed Pilot Major, an office of great consideration, and constituted inspector of all projects of discovery, which were then frequent and successful.

In 1524, an association of Spanish merchants agreed to entrust him with an expedition to the Moluccas or Spice Islands, through the newly discovered Straits of Magellan. He accordingly sailed from Cadiz in April 1525, with four ships laden with stores and articles of commerce; and touched successively at the Canaries, Cape Verd Islands, Cape St Augustine, and the Island of Paros, or of Geese. At the bay of All-Saints, he was guilty, if we are accurately informed, of a most barbarous and ungrateful action. After being liberally supplied with necessaries by the hospitable inhabitants, he seized and carried off four young men, sons of the principal people in that place. To this piece of cruelty, he soon after added another: for proceeding towards the river Plata, he landed on a desert island Martin Mendez his admiral, Captain Francis de Rojas, and Michael de Rojas, where he left them because they had censured his conduct. His eagerness to reach the Spice Islands was once more destined to be disappointed, by a mutiny of his crews, and the want of provisions. Sailing, therefore, up the Plata about 30 leagues, he there discovered an island which he named St Gabriel: it was about a league in circumference, and half a league from the left bank of the river; and here he dropped anchor. Three leagues higher up, his boats discovering a deep and well sheltered river, which he called St Salvador, he removed his fleet thither, unloaded his vessels, and built a fort, to keep the numerous natives in awe. Having left his fleet in this commodious harbour, and carrying along with him, in a float and small boats, several articles of traffic, he advanced thirty leagues more, when he came to another river called Zarcamana. The inhabitants here were intelligent and not unfriendly; for which reason he constructed on this river also a small station, and named it Santi Espiritu, though his followers called it after himself, Cabot's fort. After discovering the river Parana, and many other rivers and islands of less note, he at last arrived at the great river Paraguay; and, for the first time since his arrival on this coast, observed the inhabitants tilling the ground. Here a bloody conflict took place between his people and the Indians, of whom he made a considerable slaughter; not however without a loss on his part of 25 men killed, and three prisoners. During his excursions in those hitherto unexplored countries, Cabot was chiefly struck with two circumstances,—the number and immensity of the waters, and the innumerable population on their banks.

In the course of this winter, about the beginning of 1527, James Garcia, another Spanish navigator, entered the river Plata, and without knowing that his countrymen were in that quarter of the world, came to anchor his two vessels where Cabot's ship lay. Both these commanders dispatched messengers to Spain. They whom Cabot sent to his merchants gave them a most flattering description of the river Plata, descanted on the fertility and wealth of the vast regions conquered by the valour of their chief, and exhibited as a proof of his judgment and good conduct, quantities of gold and silver, and other precious commodities, all the productions of these countries. They demanded at the same time a supply of provisions, ammunition, and articles of commerce; together with reinforcements of men to retain the conquests. The merchants, however, disappointed in their golden dreams with regard to the Spice Islands, were not disposed to make additional advances in support of a scheme that promised but slow and moderate returns. They accordingly surrendered their rights to the crown of Castile. The king undertook to send the supplies, but many difficulties and delays occurring, Cabot was so tired with waiting, that, embarking his men and effects in the largest of his ships, and leaving the rest behind, he returned to Spain in 1531, after an absence of nearly six years. His failure in this expedition, and his harsh treatment of the Spanish mutineers, had procured him many enemies, so that his reception at court was not very flattering. He still, however, retained his office of pilot for many years, till at last, for some unknown reason, he was induced to quit Spain and return once more to Britain.

It is believed that Cabot resided at Bristol towards the close of the reign of Henry VIII.; about which time he is said to have been appointed Grand Pilot of England. Being introduced by the protector, Lord Somerset, to Edward VI., that young prince took great delight in his conversation, and granted him, in consideration of his services, or, according to some, as the salary attached to his office of pilot, the yearly sum of 166*l.* : 13*s.* : 4*d.*; a sum no doubt very considerable for those times, and which Hakluyt terms "the great pension." From this period Cabot enjoyed much consideration, and in all matters of nautical enterprise was consulted as the most competent judge in England. Being made governor of the company of merchant adventurers, his eagerness for finding a short passage to the Indies returned: the north-east coasts of Europe were still unexplored; and he conjectured that an opening might be found by sailing along the shores of Norway and Lapland. The king having accordingly, in 1552, granted his licence to man three vessels destined for this expedition, Cabot furnished the commanders with instructions, which are still preserved, and shew the sagacity and originality of this renowned seaman. Two expeditions are understood to have sailed pursuant to this project: That, however, under Sir Hugh Willoughby is the only one of which we have any distinct account; and this, it is well known, though it failed in discovering a practicable passage to the east, was productive of the important discovery, that Lapland and Greenland do not meet, and that Archangel, till then approached only by land, is accessible to ships from the Atlantic. For his great trouble in maturing these important projects, the king bestowed on Cabot a donation of 200*l.* This great man was also made governor of the Russia company, to which situation he was appointed for life by their charter; and in 1555, Philip and Mary granted him an annuity of 166*l.* : 13*s.* : 4*d.* The last circumstance on record relative to the life of Cabot is, that on the 27th of April 1556, he visited Mr Burroughes, commander of a small vessel lying at Gravesend, bound for Russia, and gave him and his men a grand entertainment on the occasion. It is probable that this veteran seaman died in the following year, at the advanced age of about 80.

No navigator ever deserved more of England than Sebastian Cabot. Skill, enterprise, and a generous enthusiasm for professional distinction, were never more happily blended in the character of any mariner; and if in command he was lofty and somewhat arbitrary, the complexion of his daring and rough crews rendered firmness peculiarly necessary. When on shore, he is described as uncommonly gentle in his manners, communicative, and easy of access. Versed in all the science of the times, he had a correct knowledge of the globe: he made "cardes for the sea," he sketched out tracts of adventure in regions which no mortal had ever seen, and was the first who noticed the variation of the compass. He published a large map, engraved by Clement Adams, a copy of which, containing some writing, was hung up in the privy gallery at Whitehall. There is also a work under the title of "*Navigatione nelle parte Settentrionale*, par Sebastiano Cabota," printed at Venice, 1583. See Hakluyt's *Voyages*, vol. iii. London, 1600; Campbell's *Lives of the Admirals*; Lediard's *Naval History*; and *Biog. Brit.* (E)

CABUL, or Kaboul, the capital of the Afghan empire. It lies in east Long. 68° 38′, N. Lat. 34° 30′. We give the following account of this place from Foster's *Travels*, which describes its situation in 1783. "Cabul, the residence of Timur Shah, and the capital of his dominions, is a walled city of about a mile and a half in circumference, and situated on the eastern side of a range of two united hills, describing generally the figure of a semicircle. The fortification, which is of a simple construction, with scarcely a ditch, and the houses built of rough stones, clay, and unburnt bricks, exhibit a mean appearance, and are ill suited to the grandeur which I expected to see in the capital of a great empire. But the Afghans are a rude unlettered people, and their chiefs have little propensity to the refinements of life, which indeed their country is ill qualified to gratify."

In the centre of the city there are four spacious bazars, or market-places, in a line, which consists of a range of apartments on each side, of two floors; the lower appropriated to merchants, and that above to private use. The intermediate space between the ranges is covered by an arched roof; and each bazar is separated by an open square, which was supplied by fountains, but now choked up with filth, or occupied by the meanest order of mechanics.

"The districts of Cabul," says Foster, "abound in excellent provisions, and its market is arranged in a neater manner, and more like that of an European town, than any I have seen in Asia. The fruits are of a good kind, and in great plenty, as apples, pears, peaches, pomegranites, and a variety of grapes."

This quarter of Afghanistan, or Cabulistan, possesses but few Indian productions: in return for sugar and cotton cloth, it sends iron, leather, and tobacco. The Tartars of Bochara bring to Cabul the horses of Turkistan, furs, and hides. The Usbec Tartars frequent Cabul in great numbers; but the Hindoos, who come chiefly from Peshour, contribute more than any other to enrich it, by their superior industry and knowledge of commerce; and they enjoy under the Afghan government, a liberty and protection, little short of that experienced by the inhabitants of our Indian possessions.

The environs of Cabul are chiefly occupied by garden grounds, and watered by numerous streams, the largest running through the city, and having a small bridge over it, affords a plentiful supply of water.

"The Afghans," to use the words of the author already quoted, "are the indigenous possessors of a tract of country which stretches from the mountains of Tartary, to certain parts of the Gulf of Cambay and Persia, and from the Indies to the confines of Persia. The inhabitants of this wide domain have no written character, and speak a language peculiar to themselves. (See Afghans.) They are a robust and hardy race of men; and being generally addicted to a state of predatory warfare, their manners largely partake of a barbarous insolence, and they avow a fixed contempt for the occupations of civil life. Though in some of our histories of Asia, the natives of Afghanistan are denominated Tartars, I am prompted to say that they bear no resemblance to that people, either in their persons, manners, or language." The Afghans are now generally allowed to be of Jewish origin: they indeed call themselves Mahometan Jews; and some modern writers have, perhaps with too much precipitation, pronounced them to be the remains of the ten tribes, which were carried captive from Samaria. (*g*)

CACALIA, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See Botany, p. 290.

CACAO. See Chocolate.

CACHAO, Chaco, Cheeo, Kesho, Keeho, or Bac-Kinh, are the various names which have been given to the capital of the empire of Tunkin. The last of these names, which signifies the *City of the North*, has been recently given to this metropolis, since the extension of the power of the emperor of Tunkin, on account of its situation towards the north of his dominions.

This town, which was formerly the residence of the Tunkinese monarchs, has neither walls nor fortifications. The streets, which are ill paved, are in general narrow, though some of them are wide and airy. The houses are low and mean, and are built of wood and clay, as the people are not permitted to build them of stone, nor above one story high. The great buildings and the pagodas, are often made of wood, in order to resist the effects of storms; but in several of them, the principal walls are built of stones or bricks, and the rest of wood. Hence these edifices, with some appearance of symmetry, are extremely irregular, and represent a shapeless mass of buildings, though amid this disorder they have often a majestic appearance, which indicates the grandeur of their possessor. From the immense quantity of wood in the houses, this town has been subject to frequent conflagrations. In order to prevent this calamity, every family is obliged to keep a cistern of water on the top of the house, and a long pole and bucket for the purpose of throwing the water upon the flame. Every family is likewise furnished with a low brick building like an oven, for the purpose of depositing their valuable property in case of any alarm from fire.

The principal building in Cachao, is the Chowa, or palace, which stood in the centre of the city, and comprehended immense gardens, and a great number of buildings. It occupied a space of two or three leagues in circumference, and was enclosed with a strong wall, in which there were four gates facing the cardinal points, and bearing their names. Before we can arrive at the interior of the palace, it is necessary to pass through several courts, in one of which are the barracks for the guards, and in the other the stables for the elephants and horses. The principal part of the palace is a square building, (a form peculiar to the habitation of the sovereign,) which is ascended by steps of marble. It is two stories high; the halls are extremely large, and are adorned with great quantities of pillars, and a profusion of gilding. The ornaments, however, are of the most absurd kind, and the gold is laid on without either taste or judgment. The only ornaments which are really fine, are the pillars, made of iron wood, which is hard and compact, and of a deep brown colour. This wood has veins like marble, and is polished to such a degree by the dry leaves of the pine apple tree, that the gloss resembles that of the finest varnish, and almost appears like the lustre of glass. The columns, though colossal, are far from being well-proportioned. Those which are placed at the gate of the palace are about 40 feet high; their circumference at the base is five feet, and they diminish rapidly towards the top. The columns have neither capital nor pedestal, but are placed upon a square stone sunk in the ground. This palace was laid waste in the civil wars which a few years ago desolated the kingdom of Tunkin; but its ruins still attest its former magnificence.

The arsenal, which is a large building, stands on the banks of that branch of the river Song-kay, which is called Dombea. The house of the English factory is situated on the north side of the city, from which it is separated by the river; on the south side of this building is the Danish factory. The city is protected from the encroachments of the river by a long dike, built with timber and stone, strongly cemented together. In different parts of the city, even in dry weather, there are ditches of stagnant water and stinking mud, which are extremely disagreeable to strangers. The situation of the town, however, is healthy, and it is seldom visited by any of those pestilential diseases which are so common in many of the eastern cities.

The Emperor of Tunkin, who resides at Phuxuan, the capital of higher Cochin-china, makes an annual visit to Cachao. The communes which lie in his route are obliged to furnish for the emperor and his suite, which resembles a little army, the necessary provisions, and also to build and furnish houses at the end of every four leagues. The furniture disappears after the emperor has passed, and must be again replaced at the next visit.

In Cachao there is a printing office, which is principally used for religious books, and for the promulgation of the laws. The characters are made of wood, and are not separate, but formed into plates as in stereotype printing. Population 40,000. E. Long. 105° 31′. N. Lat. 22° 10′. See *Exposé Statistique du Tunkin, de la Cochinchine, du Camboge, du Tsiampos, du Laos, du Lac-Tho* Par. M. M———, *sur la Relation de M. de la Bissachere, Missionaire dans le Tunkin.* London, 1811. (*o*)

CACHRYS, a genus of plants of the class Pentandria, and order Digynia. See Botany, p. 159.

CACONGO, a small kingdom of Africa, in Lower Guinea, on the north banks of the Zaire, lies between the 5th and 7th degree of south latitude. It is bounded by the kingdom of Loango on the north, and by those of Congo and Angola on the east and south, and by the Atlantic Ocean on the west. The country is in general flat, but more salubrious and fertile than either Congo or Angola; and the inhabitants, though superstitiously addicted to the same heathenish rites as their neighbours, are rather more civilized. They are, however, represented as treacherous, turbulent, and cowardly; but carry on a considerable traffic with the Dutch and Portuguese, who are not obliged to give so many presents, in order to obtain permission to trade here as at Loango. This commerce consists chiefly in certain coarse cloths, which the Dutch call *kassenbladen*; black knit bonnets; shovels, hatchets, and other iron tools; tobacco, powder, red wood, linen, and other merchandise, which they resell at Congo, Sonho, and other African states, or exchange for slaves. This kingdom is governed by its own hereditary prince, who, by certain laws of the state, is prohibited from touching any articles of European merchandise. It has a capital of the same name, which is situated in S. Lat. 5°, E. Long. 14° 20′. See Peuchet *Dictionnaire*, &c. (L.)

CACOPHONY, in music, a term sometimes used to express a jarring disagreeable combination of sounds, or a noise. The effects of the wolves or highly tempered concords on keyed instruments, which result or come out from the tuning or adjusting a certain number of other concords, have been thus denominated by Mr Hawkes, and some other writers on the subject.

CACOUCIA, or Schousbia of Willdenow, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 205.

CACTUS, a genus of plants of the class Icosandria, and order Monogynia. See Botany, p. 221.

CADER-IDRIS. See Merionethshire.

CADI. See Turkey.

CADIA, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 204.

CADIZ, a city and sea-port of Spain, in the kingdom of Andalusia, is supposed to have been founded by the Phœnicians; who, being attracted by its commodious harbour and situation for commerce, first settled a colony here, and gave it the name of Gadis, or Gadira. It was afterwards incorporated with the Roman empire, and was honoured by that people with the title of *Municipium*. Upon the decline and dissolution of that power, it fell into the hands of the Saracens, who held it, with other parts of Spain, till near the middle of the 13th century, when it was recovered by the Spaniards, and when these intruders were expelled from the kingdom of Andalusia. In 1596, it was taken and plundered by the English under the Earl of Essex; and the attempt was repeated by the Duke of Ormond in 1702, but after landing his troops he found it impracticable, and returned. During the dreadful earthquake which demolished Lisbon, November 1st, 1755, the sea rising in an extraordinary manner, overflowed the country about Cadiz to a great extent, and by its leaving behind it wrecks, which appeared to have belonged to a temple, the tradition that the ancient city of Cadiz was formerly swallowed up by the ocean, was in some degree confirmed; and it is still said, that in very calm weather, when the tide is low, the ruins of the old houses, and the remains of the temple of Hercules,* may sometimes be discerned under the water. Our belief in this tradition is also considerably strengthened by the opinion of some accurate observers, who assert, that while the sea without the straits of Gibraltar has encroached upon the land, it has receded proportionally on the coast of Spain within the straits, especially at Malaga and Carthagena.

The present city stands upon a tongue of land, projecting into the sea, and is strongly fortified both by art and nature. A steep and almost inaccessible shore defends it on the south; sand-banks and sunk rocks prevent every approach on the north; and on the south-east, where it communicates with the continent, it is protected by strong and regular bastions and out-works. Of its five gates, only one opens towards the land; which from the connecting causeway leads through the isle of Leon, and crosses the river Santi Petri by the bridge of Suazo. The streets of this city are regularly built, but rather crowded and narrow. They are, however, well paved, kept remarkably clean, and well lighted at night. The houses are neat, simple, and agreeable, with projecting roofs, made of Genoa slate, which gives rather a sombre appearance to the streets, but which affords a kind of shade in summer. On the north-east side, which looks towards port St Mary, and which constitutes the most beautiful part of the city, the houses are lofty, and ornamented with painted balconies; and in front is a wide parade, well-gravelled, and planted with trees, which communicates with the sea-road. The principal square, which is that of St Antonio, is very handsome. It has stone posts placed all round the centre, connected by an iron chain, to keep off the carriages. The ramparts form the Prado of Cadiz; and here, indeed, the walk is delightful, commanding on one side a prospect of the bay and the opposite shores, with various small towns, villages and forts; and on the other, the unbounded view of the Atlantic, on which numerous vessels are daily seen making for other ports, and bound either from or up the Mediterranean. Besides the ramparts, they have another promenade, called the Alameda, which runs by the sea, on the side of the bay, towards the west. It has three large handsome walks, planted with elms and poplars, and adorned with elegant marble seats. It is also furnished with coffee-houses, is well lighted at night, and very much frequented. Among the public buildings, the new cathedral, when finished, will be far the most conspicuous; and if executed according to the plan which it now displays, will be one of the most magnificent structures in Spain. But there is no appearance, at present, of its being soon brought to such a conclusion. It is, however, defective both in elegance and simplicity, and will never be a handsome building. The domes are lofty, and the pillars are, in general, well proportioned, and of the Corinthian order; but it is encumbered with a multiplicity of useless decorations, and though yet unfinished and full of rubbish, the niches in the walls are already filled with marble statues of saints and angels, which have been placed there with a childish eagerness. The foundation was laid about thirty years ago, and it is computed that the whole will cost 1,500,000 crowns. The old cathedral is chiefly remarkable for its pictures, most of which are copies; and its treasures, which consist of gems, many large silver candlesticks and lamps, and three custodias, one of which is constructed of the finest silver, weighing 51 arobas, and another of solid gold. The church of the capuchins,* the church of the oratory, and also some of the convents, contain some fine paintings by Murillo and other masters. The best collections of pictures, however, are to be found in the possession of private individuals. The house of Don Alphonso Ocruley contains about two hundred, almost all originals, by Paul Vermere, Rubens, Vandyke, Piombo, Murillo, Velasquez Cano, Ribalta, and the school of Breughel, &c.; and in the house of Don Josef Martinez, is to be found a superb collection of the works of Titian, Leonarda da Vinci, Velasquez, Murillo, Jules, Ribera, Herrera, Zurbaran, Jordan, Trevisani, Rosa, Vaccaro, and many other painters of the Spanish school. The asylum, or general work-house, is a handsome building, with Doric columns, and presents a front of 260 feet. It has several courts; and round the principal one is a gallery with sixteen columns of the Doric order. This asylum maintains above 800 paupers of every nation, age, or sex, who are instructed and employed in useful arts. The boys are employed in manufacturing silk, linen, cotton, and printed calicoes; the girls in spinning, in needle-work, and in household business; and the aged and infirm work according to their abilities and strength. This establishment was greatly improved by Count O'Reilly in 1785, but it again degenerated after his resignation. The other charitable institutions are; the royal military hospital, which accommodates 80 students, who are maintained and educated at the king's expence; two hospitals for the sick, one set apart for each sex; and an asylum for 47 widows, founded by a Turkish merchant.

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* This position of the temple of Hercules, however, has been disputed; some authors maintain that its site is at the mouth of the river Santi Petri, while others place it at Conil, a small town on the coast between Cadiz and Gibraltar.

The wealth of Cadiz arises entirely from foreign commerce. The advantageous situation of its harbour; its easy communication, by the Atlantic and the Mediterranean, with the different countries of Europe; and its extensive trade with the American continent, have rendered Cadiz one of the first commercial ports in the world. The trade with the Spanish colonies, which is by far the most useful and lucrative, and which was formerly confined entirely to Seville, was removed to this city in the year 1720, exclusive of all the other ports of Spain; and from its thus being the only channel through which the immense wealth of America flowed into the kingdom, it was soon raised to be one of the most opulent cities of Europe. This exclusive privilege it enjoyed for more than sixty years; and to give our readers some idea of the riches, which entered its harbour and were disseminated over the kingdom, we shall transcribe the cargoes of two vessels, the Trident and Asturias, which arrived at Cadiz on the 25th of August 1760, the one from Vera Cruz, the other from the Havannah.

FOR THE KING.

1,607,615	bars of gold,
400	plates of copper,
50	*surons* of cocoa,
834	do. of tobacco in powder,
36	bales of tobacco in leaves,
48	gold coins of different sizes,
2	bars of virgin silver,
600	chests of sugar,
9	large chests of chocolate and vanilla.

FOR COMMERCE.

4,856,062	piastres of gold and silver in coins and plate.
828	surons of fine cochineal,
132	do. of indigo,
3	do. of fine cochineal dust,
11	do. of mechoacan,
38	large chests of vanilla,
500	skins in the hair,
1	packet of emeralds,
86	large chests of tobacco in powder, jewels, and chocolate.

The fleet which left Cadiz the same year for New Spain carried out

36,279	quintals of iron,
10,672	do. of steel,
24	do. of nails,
571	do. of wire,
360	do. of manufactured iron,
118	do. of pack-thread,
1,329½	do. of pepper,
2,579¾	do. of oil,
9	do. of almonds,
188	do. of raisins,
44	do. of white-lead,
15,209	do. of wax,
173,870	pounds of cinnamon,
719	hogsheads of tin,
10,244	do. of wine,
393,842	reams of paper,
29,305	pieces of Brabant,
1,032	do. of German linen,
740	chests of books and medicines.

All the productions of the Spanish colonies were poured into Cadiz; and all the manufactures of the kingdom, as well as merchandise from various other countries, were transmitted through this channel to the ports of New Spain. But this privilege of exclusive commerce with the New World was taken from Cadiz above thirty years ago, and several other cities of Spain have been since allowed to share it equally. Cadiz has suffered considerably by this measure. It still, however, retains the greatest influence. Most of the galleons unload here, and it sends out and receives the richest fleets. In the year 1791, 176 Spanish vessels from America entered this port, by which it received gold and silver, coined and uncoined, to the amount of 5,359,203*l.* sterling; and 101 vessels cleared out for the different ports in that country, whose cargoes of national productions or merchandize were valued at 1,190,625*l.* sterling. In 1792, it exported national goods to the amount of 2,812,500*l.*, and received from America imports to the value of 7,295,833*l.* But this trade was dreadfully reduced by the war in 1801, when Spain joined France against Britain. In that year, only 20 ships entered from America, and 59 cleared out; of which 42 were for Vera Cruz, and the rest for Carthagena, Monte-Video, and Guayra. But, independent of its traffic with the New World, Cadiz carries on a very considerable commerce with most of the nations of Europe. Foreigners from every country have factories, magazines, and houses, in this city; of which the principal are Irish, and but very few English and Dutch. It has about 720 commercial houses, exclusive of retail dealers, most of them Spanish. Its harbours are continually crowded with ships from every part of the world; the bay is scarcely ever without five or six hundred; and it has been computed that about a thousand vessels annually enter its ports. In 1791, the number amounted to 1010; viz. 180 English; 116 French; 104 Portuguese; 80 Dutch; 6 Genoese; 24 Ragusians; 2 Venetians; 25 Swedish; 41 Danish; one Russian; one Hamburgh; one Imperial; 90 Americans; and 339 Spanish, of which one was from Manilla, 176 from America, and 162 from the ports of Europe. Before the revolution in Spain, the principal trade of Cadiz had been engrossed by the French, who furnished it with woollen cloths from St Valery, Amiens, Havre, and Rouen; linens from Morlaix, St Malo, and Nantes; pitch and tar from Bayonne; and lard and meal from Bourdeaux; also silks, gilt articles, iron ware, &c. from Marseilles, to the annual value of more than 500,000*l.*; and the fruits and productions of the French colonies in America; with the merchandise of the East Indies and China, which were brought in French vessels direct to Cadiz. From Britain it received pewter, lead, copper, corn, stock-fish, cutlery, earthen ware, clock-work, drabs, druggets, friezes, and different kinds of stuffs; and linen and spices from Holland. Its exports to the different cities of Europe consist of wool, wine, oil, brandy, olives, citrons, oranges, raisins, figs, vermilion, cochineal, indigo, vanilla, jalap, bark, Vicuna wool, cocoa, Brasil and Campeachy wood, hides, tobacco and salt. This last article of traffic, which is obtained from the salt pits of Puerto Real, alone amounts to upwards of 830,000*l.* sterling. The sherry wine which is annually exported from Cadiz, is about 25,000 quintals.

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* In the garden of the convent belonging to this order, there is a tree which yields the resinous gum called *dragon's blood*, and which Mr Jacob supposes to be the only one in Europe.

The manufactures of Cadiz are almost entirely confined to ribbons and silk net work, which employ about twenty looms; and a few linens. They make also vases of a kind of white earth called *barro*, which are used for filtering water.

The spirit of speculation and of trade, which prevails so much in this great commercial city, has completely absorbed all taste for science and for literature. Though Cadiz can boast of having given to the Roman empire a historian, a poet, and an eminent agriculturist,* yet in modern times it has produced no scholar, philosopher, or artist worth mentioning; and its only establishments for the cultivation of the arts and sciences are restricted, in a great measure, to military and nautical objects, such as fortification, surgery, and navigation. The school for drawing is attended by 300 pupils, and is provided with every necessary accommodation; and the observatory, which is situated in the highest part of the city, is also well furnished with apparatus. The schools for surgery are under two directors and nine professors. They have a public library and botanic garden attached to them; and 100 young men, designed for the navy, are here brought up by the government.

The climate of Cadiz is very healthy. Almost surrounded by water, the heats of summer are moderated by the sea-breeze; and, except when the *solano* or south-east wind prevails, few places enjoy a more happy temperature. This wind passes over the scorching plains of Africa, and is said to have a curious effect in inflaming the passions; for, during its continuance, it has been observed that the most irritable of the inhabitants commit every species of excess. This city is well supplied with every kind of provisions; its fruits are cheap, and the best wines are made in the neighbourhood; but lodgings are immoderately high; and all the necessaries of life are at an exorbitant price. Luxury is here carried to its greatest height, and extends to dress, carriages, houses, furniture, servants, table, &c. Every moment that can be spared from business is employed in dancing, gaming, plays, and company. The entertainments are frequent, brilliant, and sumptuous, and served with great neatness and delicacy. The higher classes are very hospitable to strangers, and possess a frankness and politeness of demeanour which is seldom found in the other cities of Spain. Cadiz had formerly a French theatre and an Italian opera, both of which were of short duration. The building of the latter has been converted into a reading room, called the *Camorra*. The national theatre is built and laid out with great taste, and is both large and commodious. It is the great resort of the higher classes; but every part of the house is private property, except one bench in front of the boxes. Gaming is the prevailing vice of this city, and is, in general, carried to a very censurable extent. An amusement common in Cadiz, is mentioned by Mr Semple in his second journey in Spain, which presents us with a faint specimen of the ancient tournament, and is to be met with, perhaps, in but few other parts of Europe. "A stand, ornamented with the arms of Spain," says he, "was erected in the centre of the great market-place, on which were placed bated swords and daggers of various lengths. A tall old man, with a large rapier, acted as umpire of the lists: the people collected, and a large ring was made. A champion approached, examined the weapons, and having found one to suit his purpose, he grasped it, and threw down his glove upon the ground. After walking to and fro for some time, an antagonist presented himself, who took up the glove, and then threw it down with contempt. He was suited with a sword; the two heroes approached, touched their hats to each other, saluted the master of the lists, and tried the length of their weapons. All being arranged, the old man gave the signal, by a motion of his rapier, and the battle began. It was contested with great skill on both sides. After a certain number of hits, the umpire declared who was the conqueror. The two parties then went round the ring, collecting donations in the hilts of their swords; and, if they had shewn much skill, had seldom reason to complain.

"If the combatants at any time became irritated, the umpire separated them until they grew cool. In the very heat of the affray, while swords and daggers were clashing, and the spectators watching the gestures of the combatants in profound silence, the sun-set bell tolled, and the weapons were immediately deposited upon the stand,—all hats were off,—and the crowd dispersed, muttering the evening prayers to the virgin."

During the fine seasons of the year, parties of pleasure crowd to Chiclana, a village about four leagues from Cadiz, and which consists chiefly of pleasure-houses belonging to the inhabitants of that city. It is a most delightful spot, and commands a fine view of the bay, the town, and the sea. But, in the midst of pleasure and profusion, this city is attended with one very great inconvenience—the want of good water. Its well water is hard, brackish, and unwholesome; and what is generally used is brought from the port of St Mary, in boats kept for the purpose, the annual expence of which is estimated at about 20,000*l*. This resource, however, also sometimes fails them, particularly in times of drought, or even when the sea is rough, or the winds contrary. What they use for the domestic purposes of washing, &c. is the rain-water which falls in the inner courts of the houses, and is collected in cisterns. The ice, which is used in great quantities, for cooling wine, making creams, &c. is brought from the mountains of Ronda.

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* Lucius Cornelius Balbus; Canius; Lucius Junius Moderatus Columella.

Cadiz is the see of a bishop, who is a suffragan to the archbishop of Seville. The see was removed from Asidonia to this city in 1262, in the reign of Alphonso the Wise, when the church of Santa Cruz was erected into a cathedral. Its diocese extends only over fifteen districts, containing twenty-eight parishes. The chapter of the cathedral is composed of six dignitaries, ten canons, four prebendaries, and eight demi-prebendaries. The government of Cadiz consists of a governor, a king's lieutenant, two assistant majors, and two alcades major for the administration of justice; and, as this city is one of the three departments of the royal navy, it has also a captain-general, a major-intendant, an accountant-general, two treasurers, a post captain, a marine minister, and two marine auditors. Since Seville fell into the hands of the French, it has been the residence of the supreme legislature, and of the executive government of the kingdom.

The bay of Cadiz is one of the finest in the world; has capital anchorage ground, and is from ten to twelve leagues in circumference. It is every where protected by mountains, except on the west, where it opens towards the ocean, and where it is defended by the forts of St Sebastian and St Catherine. The entrance into the inner bay, where the ships of war generally lie, is strongly defended by forts Louis and Matagorda, whose fires cross one another, and also by Puntal fort on the opposite shore. On the eastern extremity of this bay is the Caraca, or royal dock-yard, which contains twelve docks for building all sorts of ships of war; and three great basons, one for careening frigates, and two for careening ships of the line of all rates. It has immense magazines of naval stores, consisting of cloth, cordage, cables, anchors, arms, timber, yards, masts, and sheets of copper. Cables, sail-cloth, and ropes, are made here; and 5518 ship-wrights and others are constantly employed throughout the year.

"The rocks near Cadiz," says Mr Jacob, "are of a very singular structure. The basis of their composition is probably *pechstein;* and in this, by its glutinous power, the shells, pebbles, quartz, sand, and marble have been so intermixed and hardened in the course of years, as to form a compact kind of stone. This glutinous matter is at first of a greyish black; but in process of time, when mixed and combined with other substances, changes into a very light yellowish colour: it possesses so much tenacity, that pieces of brick, tiles, chalk, shells, and other rubbish thrown into the sea, become incorporated with it, and in time so firmly united, as to appear a piece of solid stone. It forms an excellent stone for building, is easily worked, and very durable."

In the neighbourhood of Cadiz is an extensive tunny fishery, which is a source of great traffic and profit to the inhabitants. They have a particular method of salting and preserving these animals, by which they can export them in good condition to any part of the world. Though this fish was well known to the ancients, who made it a great article of commerce, and there are still some considerable tunny fisheries on the coasts of Sicily and other parts of the Mediterranean sea; yet the inhabitants of Cadiz owe the discovery of it upon their own shores entirely to chance. A party of fishermen, when navigating towards the north-west, came to a part of the sea which was filled with moss and sea-weed. Perceiving under the weeds an immense number of tunnies, which they called *athunas*, they caught as many as they were able; and having cured them according to their own fashion, put them in barrels, and carried them home. They afterwards exported them to different ports in the Mediterranean, where they met with a prodigious sale; and this traffic is now extended to almost every part of Europe. It was in gratitude for this discovery, we are told, that the city of Cadiz stamped upon one side of its coins two tunnies, and the temple of Hercules on the other; acknowledging that it was to them it was indebted for the high station which it held among the cities of the world. The tunny fishing commences here in the beginning of May, and lasts until the middle of June.

At Cadiz, the common period for bills of exchange with England, Holland, Hamburg, and other foreign countries, except France, is sixty days after the date of the bill, with six days of grace. With France, it is only a month, with the same number of days of grace.

The population of Cadiz, according to M. de Laborde, is computed at 70,000. Mr Townshend, who visited Spain in 1786-7, reckons it at 65,987, and says, that about ten years before it had been estimated at 85,000, besides 20,000 persons who entered daily from the sea, and the adjacent country. At this place, the tide runs north-east and south-west; and at spring tides, it is high water at half past four o'clock. W. Long. 6° 11′ 50″, N. Lat. 36° 31′ 7″. See De Laborde's *View of Spain*, vol. ii. p. 69.; Collins' *Voyages to Portugal and Spain*, &c. p. 22., in Phillip's *Collection of Voyages*, &c. vols. viii. and x.; Townshend's *Journey through Spain;* Fisher's *Travels in Spain;* Semple's *Journey through Spain*, &c. vol. i. p. 141.; Semple's *Second Journey in Spain*, &c. p. 263.; Jacob's *Travels in the South of Spain*, in 1809 and 1810, p. 5, &c.; Osbeck's *Voyage to China and the East Indies*, vol. i. p. 13, &c.; *Guide des Voyageurs*, tom. i. p. 39.; and Peuchet *Dictionnaire*, &c. (*p*)

CADMUS, in fabulous history, the son of Agenor, king of Phœnicia, and brother of Europa. His sister having been carried off by Jupiter, he was ordered by his father to go in search of her, and not to return till he had found her. Being completely disappointed in the object of his mission, and not daring to return into his own country, he began to look out for a place in which he might fix his residence. By the advice of the Delphic oracle, he followed a cow, and where ever she lay down he determined to build a city. In the mean time he sent his associates to a fountain to bring water; they were all destroyed by an enormous serpent. Cadmus, not knowing what detained them, went in search of them, when he saw the dead bodies, and the monstrous serpent lying beside them. He immediately attacked the monster, and after a dreadful contest, which is beautifully described by Ovid, he slew him; and by the advice of Pallas sowed his teeth in the ground, from which immediately sprung up a crop of armed men, who were prepared to assail Cadmus. By the direction of Pallas, he threw a stone amongst them, when they immediately turned their arms against each other, and all fell by mutual slaughter, except five, who assisted him to build the walls of Thebes. Cadmus and his wife Hermione, who was given to him by the gods, were themselves at last changed into serpents.

Such is the fabulous history of this celebrated person, from which it will be extremely difficult to extract any thing like a rational meaning. It is not easy to account for the frequent introduction of the serpent in this story. Shuckford has given a Hebrew sentence descriptive of the exploits of Cadmus, which may either be translated "*He raised a company of men armed with brazen weapons*," or "*he raised five armed men from the teeth of a serpent*." This is merely conjectural, although we think it extremely probable that the greater part of mythological fables has arisen from mistranslation.

The learned Bochart has also endeavoured to show, but on different grounds, that the fabulous story of Cadmus has arisen from the errors of the Greeks in interpreting the Phœnician or Syriac language. He supposes that Cadmus was a Hivite, who fled from the face of Joshua; that the Hivites were called Cadmonites, which signifies *easterlings*, because they inhabited mount Hermon, the most eastern part of Canaan; and that Hermione or Harmonia, Cadmus's wife, had her name from this mountain. He explains the fable of their being changed into serpents, from the circumstance of their retaining the name of Hivites, which word, in the Syriac language, signifies a serpent. We want nothing here but facts, to establish the ingenious conjectures of the mythologist.

Sir Isaac Newton, with a facility of assumption which he would have been the last to countenance in physical science, supposes that Cadmus headed a colony of Phœnicians and Syrians, who fled from the conquests of David; and he alledges that he flourished about the year 1045 A. C.

Mr Bryant disputes the existence of Cadmus as an individual; but thinks, according to his usual mode of interpreting mythology, that what is in this case ascribed to an individual, applies only to different colonies, which at various periods emigrated from the East into Greece, *Cadm*, in Hebrew, signifies the East.

The only thing which seems to be known with tolerable certainty is, that Cadmus first introduced the knowledge of alphabetical letters into Greece. The Cadmean letters were sixteen in number, α, β, γ, δ, ε, ι, ϰ, λ, μ, ν, ο, ϖ, ϱ, σ, τ, υ. To these, four were added by Palamedes, in the time of the Trojan war, ϑ, ζ, φ, χ. The other four were afterwards introduced by Simonides. (*g*)

CÆCILIUS, Statius, an ancient Roman comic poet, the cotemporary and friend of Ennius, was originally a slave, and a native of Insubrian Gaul. (*Aul. Gell.* iv. 20.; *Cic Orat.* ii. 10.) The ancient authors have given us little information concerning him or his writings; but he is classed among the few Roman poets who acquired any reputation by his comedies. Horace contrasts him with Terence; the former, he says, excels in gravity, the latter in art. (*Epist.* II. i. 59.) He is also commended for his wit and humour, (*Paterc.* i. 17.); but his style is censured by Cicero: *Malus enim auctor Latinitatis est. Att.* vii. 3.

The fragments of Cæcilius have been collected, and commented upon by H. Stephen. See also the *Corpus Poetarum* of Maittaire. (*z*)

CÆMENT. See Cement.

CAEN, Cadomus, or Cathom, a city of France, in Lower Normandy, and capital of the department of Calvados, is situated in an extensive and fertile valley, at the confluence of the rivers Orne and Odon, about 67 leagues west from Paris. It is surrounded by a high wall flanked with 21 towers, and further defended by a strong castle; part of which is said to have been built by the English when they held the sovereignty of the country. The town hall is a large building, with four turrets; and the *place royale*, which is a spacious and regular square, is adorned with some very fine houses, and has an equestrian statue of Louis XIV., in a Roman habit, in the centre. Including the four suburbs, Caen has 12 parish churches, an episcopal palace, 2 abbeys, and 14 convents. The abbey of St Stephen was built by William the Conqueror, and contains the ashes of that monarch. This town has also a celebrated university, which was first founded by Henry VI. of England, in 1431, for the study of civil and canon law; the faculties of theology and the arts being added in 1436, and that of medicine in the following year, by letters patent dated from Kensington; and an academy of sciences instituted in 1706; a society of agriculture and of commerce; a lyceum, a school for navigation, a botanical garden, and a public library.

Caen has a great variety of manufactures, of which the principal are, drabs and other woollen stuffs, ratteens, serges, fustians, linens, dimities, hosiery, laces, porcelain, iron-ware, and some extensive tan-works. The drabs and ratteens are made of Spanish wool, and are in general carried to Paris. The serges are fabricated from the wool of the country; and formerly constituted the chief manufacture of this city. Before the Revolution it employed 130 looms and 250 workmen, and annually furnished from 4000 to 5000 pieces. But this number, from the numerous establishments of similar manufactures throughout France, has been reduced to nearly a third. The stocking manufacture has experienced a similar reduction, and of 500 workmen, who were formerly engaged in this trade, scarcely 100 remain in the city of Caen. Its tanneries, however, still maintain their reputation, particularly for strong leather. They work nothing but foreign hides, which they derive from St Domingo, Brasil, the Havannah, Carthagena, Curaçao, and Mexico, and which they prepare in a manner equal to any place in France.

Caen is conveniently enough situated for commerce, as it has a direct communication with the ocean by the river Orne. Its foreign trade, however, is chiefly confined to the cities of Amsterdam and Rotterdam; from whence it draws oak and fir planks, tar, campeachy wood, japan wood, and other dye woods, alum, galls, vitriol, sulphur, oil, copperas, whale-bone, lint-seed, gum-arabic, steel, tobacco pipes, delf-ware, white thread for lace, cheese, linen, and iron and copper ware; for which it returns paper, sherbet, junipers, honey, the horns and hoofs of sheep and oxen, green and dried pears, prunes from Maine, raisins from Provence, and sometimes eggs for the refining of sugar. Caen carries on also a considerable maritime traffic with Rouen and Havre de Grace, where it sends paper, iron, &c.; and receives in return.

copper and iron ware, groceries, and various other articles of national and foreign merchandise. But the most active trade is carried on at the free fair, which is held here on the second Monday after *Quasimodo*, and lasts for 15 days. This fair is one of the most crowded in the empire. Merchandize of every description, particularly woollen and linen manufactures, meet with a ready market; and cattle and horses are brought here from every quarter of Normandy and the neighbouring provinces. The goods are generally exposed to sale in booths, built under a covered market place, or under a wooden shed covered with cloth. The payments commence on the 14th day of the fair, and the protests are made on the 15th. Caen has seven other fairs during the year, each of which, however, continues only for one day. The interior commerce of this city, according to the Abbé Expilly, amounted in 1772 to nearly 4,500,000 livres.

Caen is governed by a prefect, a secretary general, a receiver general, a paymaster general, and a receiver of the customs; and is the seat of the *cour imperiale* for the departments of Calvados, Orne, and La Manche. It has also a court of criminal and special justice, a tribunal of commerce, and a chamber of manufactures, &c. The population of this city, according to the recent returns of the post-office, amounts to 36,000. North Lat. 49° 11′, West Long. 0° 17′. See Peuchet *Dictionnaire*, &c.; and Tynna *Almanach du Commerce* 1811. (L)

CAERFILLY, CAERPHYLLYON, or CAERPHILLY, (a word signifying *a castle of haste*,) is a small town of South Wales, in the county of Glamorgan, remarkable chiefly for the ruins of an immense castle. It is a neat town, with many good houses, and is situated in a broad valley, and encircled with barren and dark mountains. The Roman coins found among the ruins, sufficiently indicate the high antiquity of the place. The castle of Caerfilly is supposed by Warner, to have been originally erected in 1090, by Robert Fitzhamon, lord of the bed chamber to William Rufus; but it is the opinion of Daines Barrington (See *Archæologia*, vol. i.) that it was erected by Edward I. This extensive structure is said to have once covered an area of two acres, while its fosse was crossed by thirteen drawbridges. Its ruins are highly interesting both to the painter and to the architect. The citadel, which resembles a separate castle, is inclosed by two moats; and its gateway, which is a high Gothic arch, having its centre supported by two circular bastions, forms the western entrance to the inner court. A range of noble apartments, communicating with a long gallery, surrounds this court. The great hall, which is 70 feet by 30, and 17 feet high, is a fine specimen of Gothic architecture. The north window of the chapel is very perfect and elegant; and the mint, which is arched in a curious manner, is furnished with two furnaces for melting metal. At the east end of the inner court is the leaning tower, which is a circular building 80 feet high, and deviates 11 feet from a vertical line.

The inhabitants of this place are principally employed in the manufacture of pig and bar iron. Here is also a small manufacture of stockings and blankets; and at the fairs are sold horned cattle, horses, sheep, pigs, and yarn stockings. Number of houses 70; population 200. See *Archæologia*, vol. i. Warner's *Tour in South Wales*. Evan's *Tour in South Wales*, 1804. And Malkin's *Scenery, Antiquities, and Biography of South Wales*, 1804. (V)

CAERLEON,* the *Isca Silurum*, *Isca colonia*, and *Isca legionis secundæ* of the Romans, is a small town in Monmouthshire, situated on the river Uske, which is crossed by a long wooden bridge. The numerous remains of ancient splendour which have been found in this place; the altars, pavements, statues, inscriptions, and coins, which have at different times been discovered, sufficiently shew that it was formerly a great Roman city; while the bricks and tiles, with the inscription of LEG. II. AUG. prove it to have been a station of the second Augustan legion of the Roman army. While the Romans remained in Britain, Caerleon was the seat of government for that division of the island, which was called *Britannia Secunda*. In subsequent times it was the object of numerous contentions between the English and the Welsh, till it was finally possessed by the English, after the subjugation of the Welsh by Edward I. It continued long in the possession of the crown, but afterwards came into the family of Morgan of Lantarnon, and is at present the property of Mr Blanning.

The description of this place by Gyraldus Cambrensis, who visited it in the 12th century, is particularly worthy of notice. "*Many remains*," says he, "of its former magnificence are still visible; splendid palaces, which once emulated with their gilded roofs the grandeur of Rome,—for it was originally built by the Roman princes, and adorned with stately edifices,—a gigantic tower, numerous baths, ruins of temples, and a theatre, the walls of which are partly standing. Here we still see, both within and without the walls, subterraneous buildings, aqueducts, vaulted caverns, and, what appeared to me most remarkable, stoves so excellently contrived as to diffuse their heat through imperceptible pores." This description has been sufficiently confirmed by the antiquities which have at different periods been discovered. The form of the place, as delineated by the remains of the dilapidated walls, appears to have been nearly a parallelogram with a circular end, including an area of 530 yards by 460. The present height of the parts of the walls that remain is only about 14 feet, and their greatest thickness about 11 or 12 feet. They are built of lime-stones, imbedded in cement, some of which seem to have been tempered with pounded brick. They were faced with hewn stone, but the facings have now been removed. The whole was surrounded by a fosse; and four gates, one of which was in the centre of each wall, led to the stations in the other parts of the district. A concave space in the centre of this fortress, commonly called King Arthur's Round Table, has been supposed by some the site of a magnificent temple dedicated to Diana, while others more probably imagine it to have been an amphitheatre. The remains of stone seats which were discovered around it, seem to prove that it was a lapidean, and not a campestrian amphitheatre. Although the area within the walls of Caerleon is only about 1800 yards in circumference, yet the suburbs extended to a great distance, and are said to have covered a tract of country about nine miles in circumference.

The greater part of the antiquities found in this town have been carried away to other places. A few coins,—a rude sculpture, in basso relievo, of a Venus Marina holding a dolphin in her hand, with the carving of a large marine shell on the reverse,—and an antique intaglio, are the only specimens which remain. In 1755, a sudatory was discovered in a field near the river. It was formed of columns, constructed of round bricks, fourteen inches in diameter, and four thick. A tesselated pavement, in a perfect state, was found in an adjoining apartment. Bricks blackened with fire, and leaden pipes, were also found in the same place. In 1692, a tesselated pavement, fourteen feet in diameter, was found in a field: it had variegated borders of white, blue, and red tessela, surrounding figures of birds of the same colours. There was also on this pavement a figure of Diana, which Camden describes as clad "in tuckt up garments, with a quiver, but without head, hands, or feet." The present market-house of Caerleon is supported by four short and massive Tuscan columns, which Mr Coxe supposes to have belonged to some ancient Roman structure. Several inscribed pillars were lately dug up near the centre of the old city; and the votive stone, with the inscription

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* The name of Caerleon has been generally derived from *Caer*, a fortified place, and *legio*; but the author of the Welsh Dictionary contends, that the name should be *Caer-Llion*, or the city of Waters; while others suppose that it should be *Caer-llen*, which would signify the fortified and learned city.

T. Fl. Postumivs Varvs
V. C. Leg. Templ. Dianæ
Restituit

has induced antiquarians to believe, that this spot has been the site of the temple of Diana. Several votive altars have likewise been discovered. One of these is to the Emperor Aurelius Antoninus, and Severus Lucius his son, and alludes to the second Augustine legion. In another, the epithet Dolichius is applied to Jupiter, alluding to his being the protector of iron mines; and in a third, dedicated to Antoninus and Geta, the word Cæsar is added to the latter name. Coins of every period of the Roman empire have likewise been found here; and numerous antiquities, such as bronze figures, lamps, fibulæ, seats, rings, &c.

The ancient castle of Caerleon appears to have extended between the south side of the Roman wall and the river. On the high mound of earth called the Keep, to the north of the town, there was formerly a gigantic tower, mentioned by Gyraldus; but the only remains of it are a variety of stones near its base. There was also in this town an abbey of Cistertian monks, situated in the High Street, where there is an old house, which is the only remains of the monastery. The wooden bridge over the Uske is said to resemble Cæsar's bridge over the Rhine. The floor, supported by ten high piers, is horizontal, and is divided by posts and rails into rooms or beds of boards, each of which is twelve feet long. As the height of the water at extraordinary tides sometimes exceeds thirty feet, parts of the bridge have been carried away. On this account it is about to be replaced by a bridge of stone. The inhabitants are chiefly supported by the extensive tin works of Mr Butler, in the vicinity of the town, at which from 14,000 to 20,000 boxes of tin plates, each containing from 200 to 300 plates, are annually manufactured. There is also an iron forge here; and, by the flowing of the Uske, the town possesses a small share of the coasting trade to Bristol. The gardens and orchards of Caerleon are covered with great quantities of cinders, containing much iron. They are called Roman cinders, and appear to be the remains of ore imperfectly smelted by the Romans in their open bloomeries. Number of houses 148. Population 667. See Evan's *Tour through South Wales*, 1804. Warner's *Tour*; Coxe's *Historical Tour in Monmouthshire*, 1801; Powell's *History of Wales*; but particularly the *Beauties of England and Wales*, vol. xi. p. 124. (π)

CAERMARTHEN, or Carmarthen, the *Maridunum* of Ptolemy, and the *Caer-vyrddin* of the Britons, is the principal town in the county of Caermarthen, in South Wales. It is situated in a fruitful valley, on the acclivity of a steep hill upon the north bank of the river Towy or *Tobius*, over which there is a long narrow bridge of six arches, with other four in the parapet at the south end, to allow the water to pass when the river is swollen. The streets are numerous and handsome, though some of them are steep and irregular; and many of the modern houses are well built, and reckoned the best in South Wales. The principal public buildings are, the church, the town-hall, and the county gaol. The church, which stands without the town, at the end of Prior Street, is a very large building, and is dedicated to St Peter. The town hall is a handsome edifice, built of freestone, with colonnades of the Ionic order: The lower part of it is used as a covered market. The county gaol, which occupies the site of the old castle, is handsomely built of hewn stone.

Although this town is eight or nine miles from the sea, yet the tides which rise from eight to twelve feet, carry vessels of 100 tons burden up to the quay, which is very convenient for loading and unloading merchandise, and thus enables the town to carry on a considerable coasting and inland trade, which has greatly increased since the decline of the trade at Kidwelly.

The principal manufactures of Caermarthen are those of tin plate and cast iron, which are carried on to a considerable extent. There is also a rope-walk here, and a few vessels are built for sale. The town is well supplied with salmon and other fish, and provisions are in general reasonable.

Caermarthen was formerly defended by walls, and a strong castle, the gate of which only remains. The walls of a priory of the Fratres Grisei still exist, adjoining Lammas Street; and in Priory Street are the walls of another priory for six black canons, erected to the honour of St John the Evangelist, and founded before 1148. The principal apartments in the latter building may be still distinguished.

This town is famed for being the birth place of the celebrated magician Merlin Ambrose. On Martin's Hill, near the tower, is a rock called Merlin's Chair, from which the prophecies of the magician are supposed to have been uttered.

The government of the corporation is vested in a mayor, two sheriffs who are chosen from the aldermen, a recorder, and other officers. The chancery of exchequer of South Wales have been kept here since Wales was erected into a principality; and there is also here a court for the registry of wills, under the jurisdiction of the bishop of St David's. Caermarthen was erected into a borough by 38 Henry VIII. and returns one member to parliament. Number of houses 945; population 5548. See Evan's *Tour through South Wales*; Malkin's *Scenery, Antiquities, and Biography of South Wales*; Barber's *Tour through South Wales*; and the *Description of England and Wales*, vol. i. p. 182. (π)

CAERMARTHENSHIRE, one of the counties in South Wales, is bounded on the south by St George's Channel, on the west by Pembrokeshire, on the north by Cardiganshire, and on the east by Brecknockshire and Glamorganshire. The general appearance of this county is hilly; and towards the north and east these hills rise into mountains. The county is almost every where intersected with small narrow vallies, from the skirts of which the hills rise abruptly. The principal of these vallies is the vale of Towy, which extends thirty miles up the country, and in some places is above two miles broad. It abounds in picturesque beauties; and from the classical spot of Grongar-hill, immortalised by Dyer, and the ruined castle of Dynevor, the richest prospects are to be seen.

The principal rivers in this county are the Towy, the Taw, the Cothy, the Dulas, and the Gwilly. The Towy, which rises in Cardiganshire, enters Caermarthenshire at the north-east side, and running south-south west, it empties itself into a large bay formed by the whole coast of the county, and inclosed by the projecting shores of the counties of Pembroke and Glamorgan. The river Cothy rises on the north side of the county, and runs chiefly in a southern direction, till it falls into the Towy, about six miles above Caermarthen. The Taw, Tave, or Teivy, has its origin in Cardiganshire, and afterwards forms the boundary between that county and Caermarthenshire: After watering the north-west side of the county, it receives the Keach, and then bends its course into the county of Pembroke.

The climate and soil of this county are much celebrated. The air is reckoned milder and more salubrious than that of most of the adjacent counties; and the soil, which is less rocky and mountainous, is more fruitful in grass and corn. The flat tract of ground near Langharne, which is embanked from the sea, is singularly fertile. The climate, however, is not favourable to wheat. Barley succeeds better; and very considerable quantities of oats are annually exported to Bristol and other places. Horses and black cattle are reared in great abundance on the hills, and forms the chief article of trade in the different fairs. The county affords good pasturage; and a great deal of butter is made for exportation. The rivers of the county abound in fish; and excellent salmon, and a delicious species of trout, called *Suen*, are obtained in great quantities. The county was formerly clothed with a very considerable quantity of wood, but of late years it has suffered a great diminution. Limestone is very plentiful; and there are several mines of lead and iron. There are great lead mines some miles to the north of Llandovery. The working of these mines, and the manufacture of woollen stockings, form the principal employment of the inhabitants. A considerable quantity of pitcoal, and tinned iron plates, are exported from Llanelly, which is situated upon an arm of the sea called Burry River, which runs between this county and Glamorganshire. The exportation of coals has been greatly facilitated by a canal, which has been cut from some collieries to Kidwelly, a small town situated on a creek near the mouth of the Towy.

The length of Caermarthenshire, from east to west, is about 45 miles; and its extent, from north to south, is about 20 miles. It contains about 926 square miles, or 590,640 acres, of which 228,000 acres are in pasturage, 114,000 in tillage, and the rest in a state unfit for cultivation. It is divided into eight hundreds, viz. Carnwallon, Carthinog, Cayo, Dorllis, Elvett, Iskennen, Kirkwelly, and Perfedd. It has five market towns, Kirkwelly, Llandilovaur, Llanelthy, Llangarne, and Llandovery; and contains 145 parishes, 13,449 inhabited houses, 67,317 inhabitants, 31,439 males, and 35,878 females, of whom 4343 were returned as employed in trade, and 32,862 in agriculture. The money raised for the maintenance of the poor in 1803 was 17,046*l.* at the rate of 12*s.* 9*d.* in the pound; and the amount of the assessments under the property tax for 1806 was 378,814*l.*

Several vestiges of Roman roads, and other remains of antiquity, are still visible in this county. In Cantrebychan, to the east of Caermarthen, are the ruins of Kastelh-Karrey. It was once a large fort, and is situated on a steep and almost inaccessible mountain, near which, at a place called Kaio, are some immense caverns, which are conjectured to have been copper mines wrought by the Romans. At Kastelh-Karrey there is also a fountain which ebbs and flows twice in 24 hours. In the neighbourhood, at a place called Pont-y-Polion, were found two sepulchral stone monuments with incriptions. One of these lay flat on the ground, and was placed across a gutter; the other, which seems to be of a later date, is about a yard high, and is placed on one end. In the parish of Llan Newydh, or Llanegwad, a rude stone pillar, about six feet high and one and a half feet broad, is erected near the highway, with the inscription *Severinini filii Severi.* There are also several other pillars of this kind in different parts of the country, with Roman inscriptions. In the parish of Trelech, about 8 or 9 miles north of Caermarthen, there is a barrow called *Krig y Dyrn*, consisting of a large heap of stones about 18 feet high, 150 feet in circuit, and covered with turf. It rises with a gradual ascent from the circumference to the centre. It is hollow on the top, upon which there is a rude flat stone of an oval form, about 9 feet long, 5 feet broad, and one foot thick. This stone covers a kind of stone chest, consisting of six other stones.

A considerable quantity of silver coins of several Roman emperors were discovered about the beginning of the 17th century, at Kilmaen Lhwyd, and in the neighbourhood of a place called Bronyskawen, is a large camp named y Gaer. It is of an oval form, and about 300 yards in circumference. The rampart or bank near the entrance, is about three yards high, but in other parts generally much lower. There is a barrow on each side of the camp. The smallest one is near it, and the other at the distance of 300 yards, and both of them are hollow at the top. In the entrance to the camp, which is four yards wide, and near the surface, two rude leaden boxes were discovered in 1292. They contained 200 Roman silver coins, several of which were very ancient. See *Description of England and Wales*, vol. i. p. 178; Evan's *Tour through South Wales*; Barber's *Tour through South Wales*; and Malkin's *Scenery, Antiquities, and Biography of South Wales.* (π)

CAERNARVON,[*] the *Segontium* of Antoninus, and the *Caer-Seint* of the Britons, is the principal town of Caernarvonshire, one of the counties of North Wales. This town is pleasantly situated opposite to the isle of Anglesea; having on one side the arm of the sea called the straits of Menai, on another the estuary of the Seiont, where it receives the tide from the former; on a third side, and on part of the fourth, it has a creek of the Menai; and the remainder, according to Pennant, has the appearance of having the insulation completed by art. At a little distance from the town, and about a quarter of a mile from the Menai, is the ancient *Segontium*, which covers an oblong space of about six acres, and is placed on the summit of a rising hill sloping in every direction. There are vestiges of walls in several parts, and in one place is the remains of a building made with tiles, and plastered with hard and smooth mortar. A public road passes through the middle of this station.

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[*] *Caer ar Fon*, signifies the strong hold opposite to Anglesea.

The present town was built by Edward, after he conquered the country in 1282. It was finished in one year, and the fortifications and castle were completed before 1284. The walls and the exterior of the castle are at present exactly the same as they were in the time of Edward. The walls have a number of round towers, and two principal gates, one of which faces the east, and the other the west. The entrance to the castle is beneath a massy tower; and over the gate-way, which had four portcullisses, is placed the statue of Edward in a menacing attitude, with a half drawn sword in his hand. The castle occupies an oblong space of three acres. All the towers are either pentagonal, hexagonal, or octagonal, and two of them are much more lofty than the rest. The eagle tower, which derives its name from the figure of that bird placed upon its top, is singularly beautiful. Its walls are nine feet nine inches thick, and three slender angular turrets issue from the top of it. The walls of the fortress are seven feet nine inches thick, and have within their thickness a very convenient gallery, with narrow openings for the discharge of arrows. In a little dark room on the eagle tower, which is about 12 feet by 8, Queen Eleanor brought forth the first Prince of Wales of the English line.

The town of Caernarvon, which is neat and regular, was formerly included within its present walls, but the suburbs are now larger than the town. The houses are well built, and the streets, which though narrow and confined, are clean, and are all at right angles, corresponding with the gates. The hot and cold baths, built by the late Earl of Uxbridge, have increased the number of gay invalids who visit this place in the summer season. Along the banks of the Menai, and without the walls, there is a delightful promenade, which commands a fine view, and extends from the quay to the north end of the walls. The church of Caernarvon, which is situated about half a mile to the south east of the town, is in the parish of Llan-Beblic. The chapel of ease stands in the north west corner of the town, and the service is always performed there in English, while at Llan-Beblic it is performed in Welsh. The business of the county is transacted in the room over the eastern gateway, which was formerly used as a custom-house, for which a building has been erected within the walls. There is also at Caernarvon an extensive bowling green.

At a small distance from Caernarvon castle, near the steep bank of the Sciont, is a Roman fort. The walls, which are pretty entire on two sides, are 10 feet 8 inches high, and 6 feet thick; one of them is 74 yards long, and the other 64. Along the walls are three parallel lines of round holes, not three inches in diameter, and nicely plastered within. There are in the end of the wall similar holes, which appear to run through it lengthwise. The foundation of a tower appears near the corner of one of the walls. "This very curious piece of antiquity," says Mr Pennant, "is at present most shamefully disfigured by walls and other buildings, insomuch, that I fear my description will in a manner become unintelligible."

Though Caernarvon has no manufactory, yet it carries on a tolerable trade with London, Bristol, Liverpool, and Ireland. Vessels of near seven hundred tons can ride in safety in the harbour, but the entrance to the port is beset with extensive sand banks. The articles imported, which are considerably less than the exports, consist chiefly of Irish cloth, fine wool, hides, tallow, and groceries. Slates, to the annual amount of 50,000*l.*, are exported to London, Bristol, and Liverpool. Copper ore from Llanberis, and the Paris mount, is shipped to Swansea; and flannel webs, stockings, and an ochre found in Anglesea, are exported to America and the West Indies. Number of houses 609. Population 3626; of whom 400 were returned as employed in trade and manufactures. See particularly Pennant's *Tour through Wales*, Lond. 1810, vol. ii. p. 403; and Evan's *Tour through South Wales*. (μ)

CAERNARVONSHIRE, one of the counties of North Wales, is bounded by the sea on all sides except the east, where it borders upon Denbighshire, and a small part of the south, where it is in contact with the county of Merioneth. This county is the most mountainous in Wales, and exhibits all the sublimity and rugged grandeur which is peculiar to Alpine regions. The celebrated mountain of Snowdon, and a number of subordinate hills, with their craggy summits, deep dells, moors, chasms, and lakes, occupy the central part of the county, and are connected with another chain of hills, which extend across the county in a north west direction, from Aberconway to the sea at Aberdaron. The mountains between Caernarvon and Conway appear from the shore of Anglesea to rise in three different ranges. The lower valleys and the bases of these mountains are generally temperate and fertile. The second range affords pasturage and fuel, while the highest range is destitute of vegetation, and is covered with snow during a great part of the year. The vale of Conway, which terminates at the town of Aberconway, extends about twenty miles. It gradually widens to about a mile in breadth, and its beauty increases particularly in the neighbourhood of Llanrwst, where it is formed into the finest meadows. The declivities of the hills are well cultivated, and the eastern side of the valley, which is in Denbighshire, consists of low and broken hills, variegated with corn fields, grass, and pasturage.

The principal rivers of this county are the Conway and the Sciont. The Conway has its source in a lake, at the point where the counties of Caernarvon, Denbigh, and Merioneth meet. It runs in a northern direction, skirting the east side of the county, and after a course of 24 miles it empties itself into the Irish sea. It is navigable for about 12 miles from its mouth. The Sciont springs from a lake called Llynpris, among the hills about Snowdon, and running westward, discharges itself into the Menai Straits at Caernarvon.

The air of this county is cold and piercing. The extremities of the county near the sea are, however, fertile and populous, and yield fine barley in abundance. Between the hills there are many fruitful and pleasant vallies, which form a fine contrast with the dreary wastes which surround them. All the mountains of Caernarvonshire, and some of the low grounds on the western side, are commons. Sheep are pastured on the mountains, and black cattle on the lower grounds; and it is an annual custom among the farmers to fix the number of sheep which each shall send to the mountains. This privilege is sometimes sold by individuals for 4d. a head from May till Michaelmas. "The sheep," says Mr Pennant, "which during summer keep very high in the mountains, are followed by their owners with their families, who reside in that season in *hafodtai*, or summer dairy-houses, as the farmers in the Swiss Alps do in their *sennes*. These houses consist of a long low room, with a hole at one end to let out the smoke from the fire, which is made beneath. Their furniture is very simple; stones are the substitutes of stools, and the beds are of hay, ranged along the sides. They manufacture their own clothes, and dye them with the lichen *omphaloides*, and *parietinus*, collected from the rocks. During summer, the men pass their time either in harvest work, or in tending their herds; the women in milking, or in making butter and cheese." The preceding account, which must have been true in the time of Pennant, is contradicted by Mr Kay in his *General View of the Agriculture of North Wales*. He denies that the families live in the mountains. The wethers, according to him, are only sent up, and the ewes with their lambs are kept in the low grounds. When the lambs are weaned, the ewes are milked about two months, and the milk being mixed with that of the cows, is employed in making cheese. From the hundred of Llyn, which is in general flat, and interspersed with insulated rocky hills, oats, barley, butter, and cheese, are exported, and about three thousand black cattle were annually sold.

The immense extent of land between the counties of Caernarvon and Merioneth, called the Traeth Mawr, consisting of about 3500 acres, and forming the bottom of the Bay of Cardigan, was granted by the crown in 1807 to William Madocks, Esq. for the purpose of recovering it from the sea. This enterprising gentleman had, in August 1809, completed 1000 yards of an embankment, composed of rock and soil, and about 12 yards broad at the top. It is prevented from sinking in the sand by a thick kind of matting made with rushes, and secured by stakes. The water, which flows from the mountains about Snowdon, is to be discharged by means of five flood-gates, each fifteen feet high.[*]

The rocks, which compose the higher part of the chain that extends from Aberconway to the sea at Aberdaron, are chiefly porphyry, granite, and granitel of Kirwan. The lower rocks are principally hornblende, schiller spar, loadstone, mica slate, clay slate, mixtures of quartz, feldspar, and mica, with clay slate in all its varieties. On the west side of this range are a number of basaltic columns, on a bed of hornstone or chert, and in the fissures are found cubic pyrites, and various other minerals. At Nant-Francon are the slate quarries of Lord Penrhyn, who has constructed admirable railways, and effected a number of valuable improvements. By means of an inclined plane, and a proper apparatus on the top of an eminence, about 20 sledges are drawn up and let down at once, and when they reach the level, two horses are sufficiently able to draw them to the adjoining quay on the Menai, called Port Penrhyn. This railway cost 170,000*l.*, and the real profits of the slate quarries, to which it is attached, amounts to about 15,000*l.* per annum. Above 35,000*l.* worth of slates are annually exported from the county. A little to the eastward of Pwllhely, there is a vein of yellow ochre; near Penrhyn also there is found a blackish heavy hard stone, which is used instead of brass for supporting the pivots and gudgeons of light machinery; and towards Bardseye sound is found a beautiful red stone, which will bear a fine polish. Near Cwm Idwal, there is a quarry celebrated for excellent hones, of which great quantities are annually sent to London. Some lead mines have been discovered near Gwedir; and in the promontory of Penrhyn du, one of the points of the Tudwals bay, there have been several adventures for lead ore. Many attempts have been made to drain the mines by an engine, but the expence has always been too great. Copper mines have been wrought in various parts of the Snowdon mountains, but particularly in the neighbourhood of Llanberis. About 200 yards above the Lake Ffynnonlas are the copper mines of Sir Robert Williams, Bart., the produce of which is carried in bags for nearly a mile on the backs of men, and over one of the highest ridges of Snowdon, till it is brought to a road accessible to sledges. At Drws y Coed there were some years ago considerable adventures for copper of the pyritous kind, and thin laminæ of the native metal were sometimes found in the rocks.

The principal mountains in this county are Snowdon[†] and Penmaen-Maur. The height of Snowdon, above the level of the sea, at Caernarvon bay, is generally estimated at 3567 or 3600 feet. About 6¼ miles to the W.S.W. from Aberconway, the tremendous promontory of Penmaen-Maur rises to the height of nearly 1550 feet. Upon a ledge of this rock a good but terrific road, defended by a stone wall about five feet high, winds round the mountain. The great Irish road, however, now passes through Capel Cerrig. On the top of Penmaen-Maur there are distinct remains of a fortification, which has been fully described by the Editor of Camden, and more recently by Mr Pennant.

The lake called Llyn y Dywarchen, or the Lake of the Sod, has been celebrated, by Gyraldus, for its floating island. This island is of an irregular form, and about nine yards long. It is frequently moved by the wind; and when driven to the shore, cattle are often surprised upon it, and carried into the lake. In the winter of 1674, a pestilential vapour, like a weak blue flame, continued to rise, for a fortnight or three weeks, out of a marshy sandy tract called Morfa Bychan, and crossed over a channel of eight miles to Harlech in Pembrokeshire. It set fire on that side to 16 ricks of hay and two barns, and infected the grass in such a manner, that numbers of cattle, horses, sheep, and goats, died.[‡]

Considerable quantities of fish, but particularly herrings, are caught on the shores of this county, and lobsters and oysters are found in great abundance. Large pearls are found in black muscles, which are numerous in the river Conway.

On the coast of Caernarvon are two islands, called St Tudwal, which are inhabited only by sheep, rabbits, and puffins. The island of Bardseye, which lies about three leagues to the west of Aberdaron, is about two miles in circumference, and was once famous for its convent, which was the resort of numerous monks.

This county is about 45 miles long, 13 broad, and 150 in circuit. It contains about 310,000 acres, of which 160,000 are in a state of cultivation, or pasturage, while 100,000 are unfit for culture. It contains 8304 inhabited houses, and 41,521 inhabitants; 19,586 males, and 21,935 females, of whom 4234 were returned as employed in trades, and 12,808 in agriculture. It contains one city, viz. Bangor, the county town Caernarvon,

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[*] A full account of this plan will be found in a Note by the Editor of Pennant's *Tours in Wales*, vol. ii. p. 364. Lond 1810.

[†] See the article SNOWDON, for a full account of this celebrated mountain.

[‡] See Camden, vol. ii. p. 788; *Phil. Trans.* No. 288. p. 49; or Hutton's *Abridgement*, vol. iii. p. 618; and Pennant's *Tour*, vol. ii. p. 372.

10 hundreds, 5 market-towns, and 71 parishes. The amount of the assessments, under the property-tax for 1806, was 131,806*l.* and the money raised for the poor in 1803, was 9137*l.* being at the rate of 4*s.* 0¾*d.* in the pound. See *Description of England and Wales*, vol. i. p. 197; Pennant's *Tours*, vol. ii. p. 299, &c.; Kay's *View of the Agriculture of North Wales*; Evan's *Tour through North Wales*; *A Sketch of the History of Caernarvonshire*; Aikin's *Journal of a Tour through North Wales*, and *A Tour in Wales, and through several of the Counties of England*, &c. in 1805; in Phillip's *Collection of Voyages*, &c. vol. iv. p. 119, &c. (π)

CAERWENT, the *Venta Silurum* of the Romans. The ancient fortress, for which alone it is deserving of notice, is of an oblong form, rounded at the angles, and is 505 yards long by 390. Each corner corresponds with the cardinal points; and at the south-west side there are three pentagonal bastions. The rampart, which is nearly a mile in circuit, may still be traced, and it is surrounded in most places by a deep fosse. About 50 years ago, a curious tesselated pavement was discovered. It is 21 feet long, and 18 broad, and has a border of variegated stones. Columns and coins are frequently found, when the ground is turned up by the plough. Number of houses, 55. Population, 329. See Evan's *Tour through South Wales*; Barber's *Tour through South Wales*; and Coxe's *Tour in Monmouthshire*. (π)

CAERWYS, the name of a small town of Flintshire, which is mouldering away with age. It stands on a rising ground, and consists of four spacious streets, crossing each other at right angles, and corresponding to the points of the compass. Several Roman copper coins have been found here; and a stone, four feet six inches high, and three inches broad, was discovered in an upright position, with the inscription—*Hic jacit mulierbo - - - - obiit*. This curious relic, which was used as a gate-post, has been lately removed to the garden at Downing.—Multitudes of tumuli are scattered over the neighbourhood; and Pennant seems to think that the preceding inscription refers to a heroine, who fell in the field of battle. The derivation of *Caerwys*, from *Caer*, a city, and *Gwys*, a summons, shews that it was once a seat of judicature for this part of Wales. It had its town-hall and its jail, and continued to be the place of judicature till the middle of the 17th century, when the courts were removed to Flint. Caerwys is famous for its eisteddfod, or session of bards and minstrels, which was held here for many centuries. A silver harp was annually given to the best bard or musician, but this custom was discontinued after the eisteddfod of 1568, held by a commission from Queen Elizabeth. In 1798, this custom was resumed, but we do not know if it has been continued. Caerwys had formerly the most considerable fairs in the county for cattle, sheep, and horses; but these have almost entirely failed, since the increase of Holywell. Number of houses, 138. Population, 773. See Aikin's *Tour in Wales*; Evan's *Cambrian Itinerary*; Pennant's *Tours*, vol. ii. p. 77—105, where a complete account of the Eisteddfod will be found; and Powel's *History of Wales*. (π)

CÆSALPINIA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 203.

CÆSALPINUS. See History of ANATOMY, vol. i. p. 724.

CÆSAR, CAIUS JULIUS, the first Roman emperor, is one of the most extraordinary characters that have appeared in the history of the world. Cæsar was born of an illustrious family, though his immediate ancestors had been but little distinguished. The Julian family laid claim to high antiquity; and the refined flatterers, who were patronized by the liberality of Augustus, have consecrated these pretensions by the elegant productions of their genius, and taught us to consider the Julian family as lineally descended from the son of Æneas.

> Julius, a magno demissum nomen Julo. Virg.

We know little of the parents of Cæsar; all that we know respecting his father is, that he dropt down dead one morning when he was putting on his shoes; and of his mother Aurelia, it is said, that she was a matron of noble family, and great propriety of manners; and that she bestowed the utmost attention on the education of her son. The youth of Cæsar seemed, to ordinary observers, to afford no indications of his future greatness; it was spent in turbulence, profusion, and profligacy. He was notorious for the most unmanly and disgusting debauchery; and all the splendours which afterwards surrounded his name and his family, have not been able to screen his vices from the lash of satire. With the habits of a rake and a coxcomb, few people apprehended any danger to the republic from his exertions; even Cicero, after he began to entertain some suspicions of his intentions, was deceived by these appearances, and said, that he could not conceive the state had any thing to fear from a man so finical in his dress; and so much afraid of deranging the economy of his hair, that he scratched his head with one finger.

He had given early proofs of aspiring ambition; and his connections at first were such, as to promise the attainment of his object with little trouble. Marius was married to his aunt; and, to strengthen his interest with that party, he himself married Cornelia, the daughter of Cinna. Through the influence of these powerful leaders, he was chosen *Flamen Dialis*, or priest of Jupiter, when he was only about seventeen years of age. On the ruin of this party, Cæsar became an object of jealousy to Sylla, who had sufficient penetration, even at that early period, to appreciate his character. When those around the dictator represented Cæsar as too insignificant to excite any apprehensions, he replied, with a kind of prophetic sagacity, that *he saw many Mariuses in that dissolute youth*. Indeed, he gave at that time a proof of intrepidity, unexampled in that reign of terror; he had the boldness to resist the command of Sylla to divorce his wife, by means of whom he was so closely connected with the opposite faction; and chose to go into a voluntary exile, rather than purchase security by a dishonourable sacrifice, or yield obedience to a tyrant's will.

As Cæsar seldom did any thing which had not a tendency directly or indirectly to the great object of his life—his advancement to power,—it is probable, that his opposition to the will of Sylla, is to be set down to the score of his ambition, rather than ascribed to conjugal fidelity. He married Cornelia for political purposes, by breaking his engagements with another; and he would have parted with her with the same facility, could his views have been promoted by the measure. But it seems to have been his wish to appear as a martyr to the cause of Marius, which had always been popular with the multitude, through whose means he intended to climb to power.

Finding it expedient to leave Rome, which was at that time entirely under the dominion of his enemies, he resolved to prosecute those studies, for which he was so eminently qualified by nature, and which were absolutely necessary for every one who wished to make a figure in the state. In that age of Rome, scarcely any man could hope for influence, unless he had riches to bribe the unprincipled, or eloquence to protect the defenceless. By the judicious application of the latter quality, Cicero had raised himself to the highest honours of the state; but Cæsar, who looked far beyond the legitimate honours which satisfied Cicero, wished to combine in his own person every qualification which could smooth the way to absolute authority. He saw that eloquence was necessary to give eclat to wealth, or to justify its misapplication. Crassus, the richest man in Rome, never had been respected, because he was known to be of sordid habits and mean capacity; and though be had ambition to aspire to absolute power, and money sufficient to have bought it, yet, as he wanted abilities to wield such a cumbersome and dangerous instrument, he never became an object of jealousy to the state. Unfortunately all these qualities were combined in Cæsar: his ambition knew no bounds; his wealth, which was considerable, was most profusely lavished on the needy and undeserving; whilst his abilities ranked him with the first characters that Rome or the world ever produced.

To improve his eloquence, he resolved to spend the time of his retreat from Rome, under Apollonius Molo, a celebrated rhetorician at Rhodes, who had also been the master of Cicero; and who thus had the honour of having for his pupils two of the most extraordinary men who have figured on the theatre of the world. On his way to Rhodes, he was taken by pirates, with whom he lived upwards of a month, till he could procure money to purchase his freedom. During this interval we are told by Plutarch, that he lived very much at his ease, engaging in all the exercises and diversions of the pirates, delivering orations to them, and calling them brutes and barbarians, when they did not appreciate the merit of his compositions. He also threatened to crucify them all, as soon as he should obtain his liberty: the pirates laughed at these threats, and considered him as a pleasant fellow: it was not long, however, before he had an opportunity of carrying them into effect. He manned a few vessels in the port of Miletus, and attacked the pirates whilst they were lying at anchor in perfect security. He took the greater part of them prisoners, and immediately applied to Junius Silanus, proconsul of Bithynia, for an order for their execution; this being refused, he hastened to the place where he had left them, and had them all nailed to the cross, before instructions could arrive to prevent it.

After the fears excited by the proscription were removed, and the vanquished Marian party began to think of again lifting its head, Cæsar was earnestly solicited by his friends to return to Rome, that the party might be supported by his known talents and intrepidity. He began his political career in the way common amongst young patriots at Rome, as well as in other countries, by professing great zeal for the purity of the administration, and by publicly impeaching some persons of great influence, and high in authority. Though he was baffled in several of these attempts, he did not fail to gain his end, by thus securing the admiration and confidence of the multitude. His purse was always open to the indigent; his eloquence and his patronage were at the service of the most profligate: his only object was to gain devoted partisans, and he was nowise scrupulous about the means employed to obtain them. He soon had a proof of the favour of the people, in carrying the office of tribune of the soldiers, in opposition to a powerful competitor; and, shortly after, it was manifested in a more decided manner, when he pronounced the funeral oration of his aunt Julia, the wife of Marius. On this occasion, he had the hardiness to produce the images of Marius, which had not been seen during the administration of Sylla and the prevalence of his party, as all of the Marian faction had been declared to be enemies to the state. A great clamour was raised against Cæsar by the patrician party, whose authority had been established by Sylla; and it is probable that he might have suffered for this indiscretion, had he not been supported by the unanimous voice of the people, whose acclamations and avowed admiration showed his enemies that it would be in vain to attempt any thing against him.

He continued to cultivate the favour of the people by acts of unbounded munificence; and those who had begun to apprehend danger from his designs, now dismissed their fears, by anticipating the total ruin of his fortune. His expenditure during his ædileship, in the exhibition of games and public entertainments, exceeded any thing that had been seen at Rome on similar occasions. He produced three hundred and twenty pair of gladiators, to slaughter each other for public amusement; a kind of entertainment of which the Roman people were distractedly fond, and which sufficiently marks their brutal and ferocious character.* In the midst of these popular exhibitions, he ventured to give a still more daring and decided proof of his contempt for the aristocratical party, than any which he had hitherto displayed. He caused images of Marius to be made of the most costly materials, and most exquisite workmanship, together with a representation of his victories over the Cimbri, and in one night placed them in the capital. Nothing could exceed the public astonishment, when they were next day exhibited to view. The senate was assembled on the occasion; and Lutatius Catulus, one of the principal men of Rome, publicly accused Cæsar of a design against the state, declaring, that no longer content with sapping the foundation of the commonwealth, he now attacked it by open force. But Cæsar's abilities, profusion, and intrepidity, had secured him so many friends, even in the senate, that he was publicly acquitted.

After this success, he ventured to measure his strength with the principal men of Rome. The office of *Pontifex Maximus* falling vacant by the death of Metellus, Lutatius Catulus, prince of the senate, and Servilius Isauricus, a man of high military reputation, under whom Cæsar had served his first campaign, declared themselves candidates. Cæsar, though greatly inferior both in age and dignity, ventured, nevertheless, to enter the lists with these powerful competitors. He seems to have staked his prospects and his influence on the issue of this contest; for when his mother, on the day of election, expressed her anxiety, he declared, that she should that day either see him high priest, or an exile. Never was any election more keenly contested. It was a trial of strength between the patrician and popular parties; and the triumph of Cæsar was so complete, as scarcely to leave any room for contest in future; for on taking the suffrages, he had more votes against them in their own tribes, than they were able to procure among all the other citizens. *Sueton. in Cæs.* xiii

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* Credo, imo scio nullum bellum tantam cladem vastitatemque generi humano intulisse, quam hos ad voluptatem ludos. Mentior si non unus aliquis mensis Europæ stetit vicenis capitum millibus, aut trecenis. Lipsius. Saturn. i. 12.

The same year in which Cæsar obtained the priesthood, Catiline planned his famous conspiracy, which has been so ably recorded by Sallust the historian, and which procured so much eclat to Cicero, from the vigour which he manifested in its suppression. Cæsar was not only suspected, but publicly accused, of being privy to this conspiracy; and it perhaps would be difficult to defend him from the charge; he had probably more sense than to join his flourishing fortunes with such a desperate adventurer as Catiline; but it is as probable that he would rejoice in any commotion, perhaps even in the subversion of the state, as this would afford a proper field for the exhibition of his talents, and for procuring that absolute ascendency at which he uniformly aimed. His speech, recommending lenity to the conspirators, was injudicious, considering the suspicions which were attached to him, and had nearly been attended with fatal consequences to himself: for Cato's speech in opposition to the sentiments of Cæsar, and in which, as Plutarch informs us, he expressed his suspicions of his principles, had produced such a spirit of enthusiasm on the minds of all who heard it, that the Roman knights, who had assembled as a voluntary guard around the person of Cicero, rushed upon Cæsar with their swords, as he left the senate-house, and looking to the consul for a nod of approbation, would have instantly dispatched him, had Cicero given his assent. At this critical moment, Cicero interposing, and covering him with his gown, rescued him from his dangerous situation.

Cæsar was next, in the regular gradation of office, advanced to the prætorship, and during his administration of this department, the commonwealth enjoyed a short respite from his intrigues. A disagreeable occurrence, however, happened in his family, which seemed to give him but very little uneasiness. Publius Clodius, a young Patrician, of high birth and ample fortune, but of the most abandoned and profligate character, had entertained a criminal passion for Pompeia, Cæsar's wife, which she did not discourage; but they had no proper opportunity of an interview, on account of the vigilance of Cæsar's mother. It was therefore agreed, that Clodius should be introduced in woman's clothes, during the celebration of the mysteries of the *Bona Dea*, to which no male creature was admitted.[*] One maid only was in the secret, but she happening to be out of the way when Clodius entered, he was discovered by his voice, and with difficulty escaped from the fury of the enraged matrons. This story made a great noise at the time; but Cæsar took it very coolly: he said, that he did not believe it; but he nevertheless divorced Pompeia, alleging as the reason, not her guilt, but the sacredness of his honour, and saying, that *Cæsar's wife ought not even to be suspected.* The truth is, he was anxious to conciliate Clodius, who was the most popular and the most furious demagogue that ever appeared in Rome, and whose assistance he saw must be of infinite service to him.

On the expiry of his office as prætor, Cæsar obtained his first military command, and was appointed, by lot, to the government of Lusitania, comprehending nearly the modern Portugal and Andalusia. He had so completely involved himself by his boundless profusion, that his creditors interfered, and prevented his departure. On this occasion, Crassus stood forward as his surety, for considerably more than a million of our money, (*Bis millies et quingenties.*) Cæsar made a joke of this circumstance, and said that he wanted this sum to be worth just nothing at all. In modern times no man could think of repairing such a ruined fortune; yet Cæsar soon found means of repaying the sum, and of undertaking, at his own expence, the most magnificent public works that ever had been seen at Rome. This is easily accounted for, when we consider that extensive provinces were entirely at the mercy of their governors, who could make whatever exactions they pleased; and though they were often accused of peculation, yet it was never till they had amassed such a fortune as to render them formidable; and, in general, completely to screen them from punishment. In passing the Alps, on his way to Spain, one of his attendants, pointing to a small village, said, *Here too, it is probable, there are parties, and contests for power.* To which Cæsar replied, "I would rather be the first man here, than the second man in Rome."

In his government in Spain he contrived to quarrel with the natives, that he might have an opportunity of bringing into view those military talents which he possessed in such an eminent degree; and his success was such, that on his return to Rome he publicly claimed a triumph. Unfortunately, however, he had two objects in view, which could not easily be reconciled; he solicited at the same time a triumph, and the consulship: to obtain the first object, it was necessary, according to immemorial custom, that he should remain without the city, till the sentence of the senate should be known; and there had been instances of commanders waiting for months in that situation, in hopes of being able to enter the city in triumph. On the other hand, in order to obtain the consulship, it was necessary that the candidate should be within the city, to solicit in person the suffrages of the people. Cæsar at first tried to get this law dispensed with, but as Cato violently opposed the innovation, he resigned his pretensions to the triumph, that he might enjoy the more substantial honours of the consulship.

Cæsar, knowing well how much his character and designs were now suspected, had recourse to an expedient, which, whilst it paved the way for him to the honour which he desired, sealed, at the same time, the subversion of the commonwealth. The two most considerable men in Rome at that time were Pompey and Crassus; the one for his popularity and power, the other for his enormous wealth and extensive patronage, which gave him great influence in the state. Between these two, there had long subsisted such a jealousy as generally takes place between persons who have the same object in view, which both cannot obtain. Cæsar paid court to both: and on the present occasion, he showed them the advantage of union; convinced them that they might obtain whatever they pleased, by joining their influence; but that certain disappointment would be the consequence of disagreement. They easily perceived the justice of this reasoning, and assuming the author of the measure as their associate in their scheme of appropriating to themselves the power of the state, they entered into that famous league, commonly known by the name of the first Triumvirate. By the aid of two such powerful friends, Cæsar secured his election; the Patrician party, however, prevailed so far as to get another popular candidate excluded, and to introduce Bibulus, to whom they looked as a check on Cæsar. Bibulus, it appears, was a worthy character, but destitute of sufficient energy to contend with such a colleague as Cæsar. He stood out, however, till his life was almost in danger from popular violence, and then he confined himself to his house; contenting himself with publishing edicts in opposition to the measures of his colleague. So inefficient, however, were all his measures, that it was a common joke to designate the period of his consulship, by saying, *Julio et Cæsare consulibus*.

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[*] Ubi velari pictura jubetur
Quæcumque alterius sexus imitata figuram est. JUVENAL.

Cæsar, to secure still farther the affections of the people, proposed and carried an Agrarian law, by which he was to provide for twenty thousand poor citizens. This was the usual way in which factious demagogues courted popular favour, and was always strenuously opposed by the senate. Indeed, no plan could be conceived more injurious to the state, than that which proposed a premium to idleness. It was not the law, however, which the senate opposed so much on the present occasion, as the influence of the man who proposed it. "It is not this law which I dread," said Cato, "but the reward expected for obtaining it." This stern senator, therefore, resolved to brave the odium of the people, and to oppose, to the utmost, the measures of their favourite. For this purpose he determined to avail himself of his privilege of speaking in the senate without interruption, that so he might exhaust the whole time of the sitting, and prevent them from coming to any conclusion. Cæsar suspecting his design, and seeing no other way of preventing it, ordered him into custody. This was a very unguarded measure, and he soon found that he had carried his audacity too far: for the whole senate rose in a tumult, and prepared to leave the house. "Whither are you going?" said Cæsar to Petreius, who was moving from his side. "I go," said he, "into confinement with Cato: a prison with him is preferable to a place in the senate with you." Cæsar had counted on their want of decision; and was disappointed when he saw the spirit which they manifested on this occasion. Cato perceiving his embarrassment, resolved that he should have the full odium of the measure; and therefore delivered himself without reluctance into the hands of the lictor. Cæsar soon recovered himself, and sent a tribune of his own party, with secret instructions to rescue the prisoner.

But the most odious of all his acts, during his consulship, was the purpose which he formed of ruining Cicero, by seconding the views of Clodius. It was no obstacle that this libertine had been accused of dishonouring his bed; he was anxious to destroy the influence of Cicero, who had publicly lamented the situation of the commonwealth, in being subjected to a cabal, which governed by violence and in contempt of law. Cæsar was highly offended, and resolved to get rid of a person who was so capable of counteracting his views. Clodius had long been labouring to accomplish the destruction of the same illustrious person; and was at that time endeavouring to get himself adopted into a plebeian family, that so he might be qualified to be elected tribune of the people. He knew, that if he could accomplish this object, he would be able to carry whatever measure he pleased. There were, however, considerable obstacles in the way, and Clodius could not obtain the ratification of his adoption in the assembly of the Curiæ; but this act of ratification was passed on the very day on which Cæsar took offence at Cicero. The issue is well known: this father of Roman eloquence, and not long before the preserver of the state, was sacrificed to the hatred and ambition of two unprincipled individuals, and forced to retire, for a time, from a country no longer worthy of his virtues.

With these transactions, Cæsar's consulate drew to a close. He ratified his treaty with Pompey, by giving him his daughter Julia in marriage; he gratified the vanity and avarice of Crassus, by entrusting him with a lucrative commission; and in one way or other he tied up the hands of every man who had power to hurt him. He himself married the daughter of Piso, who was next year to succeed to the consulship, and by this alliance secured him in his interest. On hearing of these political marriages, Cato exclaimed, "Provinces and kingdoms are made the dowries of women; and the empire itself an appendage of female prostitution."

Though Cæsar had advanced so far and so successfully, much yet remained to be done, before he could openly sieze the government of the state. The power and popularity of Pompey were still enormous; and Cæsar saw that nothing could be effected without a strong military force. Such a force, however, could not be maintained within Italy; for the senate, with a well-grounded jealousy, had prohibited any military station within that country. Cæsar therefore cast his eye on Cisalpine Gaul, which he saw would answer all his purposes, from its vicinity to Rome. The tribune Vatinius, accordingly, who was completely devoted to the interests of Cæsar, upon a report that the Helvetii were likely to cause some disturbance on the frontiers of Gaul, moved the people, that, by virtue of their supreme power, they should nominate Cæsar as Proconsul of Cisalpine Gaul and Illyricum, for five years, with an army of three legions. This was contrary to all law; the allotment of the provinces had always remained with the senate, and no appointment was made for more than one year; unless it was renewed at the end of that term, it virtually expired. This, however, did not prevent the people from granting this illegal appointment to Cæsar. The senatorian party were greatly alarmed at this measure, and endeavoured to evade it by nominating Cæsar superintendant of the public forests of the empire. Finding, however, that he was not to be driven from his purpose by such a weak artifice as this, they took different grounds, outstript the people themselves in the liberality of their grants, and added Transalpine Gaul to the province already decreed to him by the people, with the addition of another legion. It is not easy to say whether this measure proceeded from fear or from policy: they either saw that it was in vain to oppose him, and therefore wished to make a merit with him for their concessions; or they hoped that the five years of his government would be completely taken up with the wars which they expected to arise beyond the Alps.

As it is our design to follow the political rather than the military career of this extraordinary adventurer, we shall not detain our readers with a detailed account of his eight campaigns in Gaul, nor of his two descents on Britain. He was not less ambitious of military fame, than desirous of unrivalled power; and all his campaigns were conducted with an ability, to which nothing but his own admirable *Commentaries* can do sufficient justice. He contrived even to give a colour of justice and humanity to his bloody operations in Gaul, by stating himself as the protector of the native inhabitants, against the invasions of the Helvetii and the Germans. His laurels were indeed deeply stained with blood: for his wars in Gaul cost not less than one million two hundred thousand lives. But this goes for nothing in the estimation of those who aspire to the title of conquerors. The Romans, in particular, were regardless of the justice of their wars, and the effusion of hostile blood; and we shall perhaps search in vain in their history for a just war, except when they were engaged in the defence of Italy. Cæsar gained two very important objects by his wars in Gaul; a high military reputation, and an army devoted to his interests. He indeed omitted no means which could secure the attachment of his troops: he shared with them every danger; and they had such confidence in his skill, that they engaged with alacrity in whatever enterprize he thought proper to recommend. In the meantime he did not neglect his interest at Rome. He frequently spent the winter in Cisalpine Gaul, that he might the more easily communicate with his friends in Rome. Pompey and Crassus waited on him at Lucca, a town within his province, where they renewed their former association, and entered into an agreement respecting the partition of the empire. Pompey and Crassus were to stand for the consulship; and at the expiration of their office, the former was to have Spain, with an army: Syria, the most lucrative province, was assigned to Crassus, with a sufficient military force to carry on such operations as he might choose to undertake: whilst Cæsar only stipulated for himself the continuance of his government in Gaul, the poorest and most difficult station, but to him the most valuable, from the facility which it afforded of accomplishing his views.*

During Cæsar's first expedition to Britain, an event occurred of great political consequence, which the Roman writers have generally considered as hastening the disastrous events which followed: this was the death of Julia, the wife of Pompey, and daughter of Cæsar. She is universally allowed to have been a woman of great prudence and accomplishments, and to have had much influence both with her father and her husband. The poet Lucan laments her death as a public calamity, and as the signal of strife between her ambitious relatives.

> Parcarum, Julia, sæva
> Intercepta manu. Quod si tibi fata dedissent
> Majores in luce moras, tu sola furentum
> Inde virum poteras, atque hinc retinere parentem;
> Armatasque manus excusso jungere ferro,
> Ut generos soceris mediæ junxere Sabinæ.
>
> Pharsal. l. i. v. 113.

Such was the general opinion respecting the disagreement between these two powerful rivals; it was considered as the immediate cause of the subversion of the commonwealth; but Cato said that it was not their disagreement, but their union, which had ruined the state. It is certain, that both parties from this period began to consult more avowedly their individual interests. Cæsar now paid more than usual attention to all intelligence from the city; and was at the utmost pains to secure every person who could be of service to him in the conflict which he saw approaching. He now paid particular court to Cicero, who had been recalled from his banishment: he knew well the weak side of this great man, and by addressing his vanity, or as Cicero himself called it, his love of glory, he hoped to secure his neutrality, if not his active co-operation. For this purpose he consulted his taste with regard to the public buildings which he intended to erect at Rome; carried on a close correspondence with him during his campaign in Britain, and whilst chasing the painted savages into their native woods, he read, criticised, and affected to admire the poetry of Cicero.

Whilst things were in this situation, Rome was the scene of the utmost confusion. Clodius had long, by intrigue and violence, interrupted the operations of the government, and being supported by the mob and a body of armed gladiators, he set at defiance the laws and the magistrates. Milo, a person of great courage, and attached to the senatorian party, resolved to combat him in his own way. For this purpose, he also hired a band of gladiators, and prepared to oppose force to force. Many sanguinary rencounters took place in the midst of the city; and the streets were sometimes flowing with the blood of the slain. At last, Clodius and Milo having met accidentally about fifteen miles from Rome, a quarrel ensued, and Clodius fell in the conflict. Unheard of outrages followed this event; the populace carried the body into the senate-house, tore up the benches, and heaping them together, burnt the body on this new species of funeral pile, and along with it burnt down the senate-house and several contiguous buildings. Pompey's friends hinted at the necessity of a dictator, to put an end to these disorders; but as this was a measure never resorted to but in cases of the utmost emergency, and had become more than ever suspected since the dictatorship of Sylla, it was at last concluded that Pompey should be named sole consul. Even Cato consented to this novel plan, as being the only remedy in the present distracted state of affairs at Rome. This step, however, gave great advantage to Cæsar; he was already prepared to make any demand; and he was now furnished with a pretext for doing it, under some colour of justice. His command in Gaul was soon to expire; and according to the laws then in force, he must resign it before he could aspire to the honour of the consulship. To prevent the conjunction of civil and military power in the person of any individual, it had been ordained by the laws, that no man should enter the city, or even go beyond the limits of his province, without resigning his command, and dismissing his army; and that no one should be permitted to stand candidate for the consulship, without appearing at Rome, and suing for it in person. These formalities, however, had been dispensed with in the case of Pompey, who, though vested with a military command in Spain, not only resided in Rome, but had been raised to the consulship.

Cæsar, therefore, to keep pace with his rival, aspired to the same privilege, and asked, as a mere matter of justice, what the other had obtained, but what, in his circumstances, would give him a great and decided superiority; for the addition of consular power at Rome, to that of general in both the Gauls, was joining Italy itself to the provinces, and making him at once master of the empire. To promote these views, the tribunes in Cæsar's interest moved, that, as he was detained abroad in the service of his country, and engaged in hazardous wars which required his presence, he should be exempted from the law which enjoined the candidates for office to attend the canvass in person, and might be elected consul without presenting himself to the people.

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* Florus expresses very neatly and very justly, the views of these different leaders in their original compact. "Sic igitur Cæsare dignitatem comparare, Crasso augere, Pompeio retinere, cupientibus, omnibusque pariter potentiæ cupidis, de invadenda republica facile convenit."

It was not difficult to perceive the tendency of this proposition; but things were now in such a state, that it was equally dangerous to grant or to refuse the demands of Cæsar. Pompey could not decently oppose, in the case of his rival, a privilege which had been conferred on himself; and Cicero, either to soothe the ambitious mind of Cæsar, or to prevent an immediate rupture, recommended compliance with his request. He represented the danger of a quarrel with Cæsar; but did not consider, as has been well observed (Ferguson's *Rom. Hist.*), that he was then giving up without a quarrel, all that any quarrel could extort.

Cæsar's power and general conduct now began to excite serious apprehensions. The continual augmentation of troops in his province, his great military reputation, his insinuation, his unbounded liberality, his assiduity in excluding from power every one who could oppose his interests, were viewed with general alarm. When, therefore, the regular election of consuls took place, Marcellus, who had been elected along with Servius Sulpicius, made a motion in the senate, which hastened the crisis which every prudent man had long foreseen. In deliberating on the appointments in the provincial governments, he moved that, the war in Gaul being finished, Cæsar should be recalled; or if his friends insisted on his continuing in his command, that he should not be admitted on the list of candidates for the consulship, till he presented himself personally for this purpose.

This motion gave rise to long and violent debates. Many strong resolutions were carried in the senate, and as often defeated by the negative of the tribunes, who were always in the interests of Cæsar. This aspiring adventurer had now this advantage on his side, that all the measures proposed in the senate against him, had the appearance of direct hostility and injustice, as they had for their object to reverse decrees which had lately been solemnly made in his favour, both by the senate and the people. Pompey perceiving this, affected to censure the violence with which it had been proposed to recal an officer legally appointed before the expiration of his term. Shortly after, however, he sufficiently disclosed his sentiments and feelings on the subject, by saying in the senate, that although he did not think that the proconsul of Gaul could be instantly recalled without injustice, yet that after the first of March, (this day having been specified in the senate,) he should have no difficulties on the subject. "But what," says one of the senators, "if Cæsar still persist in demanding the consulship while he retains his province and his army?"—"What," replied Pompey, "if my own child should offer me violence?"

These proceedings sufficiently pointed out to Cæsar what part he was to act. After defeating the Gauls and the Germans in every attempt to regain their freedom, he endeavoured to conciliate their affections, that his hands might be free for a more important enterprize. He established a chain of military posts from one end of his province to the other, that his troops might be ready to act in any emergency, or in any direction; whilst he himself remained in the station most distant from Italy, with a view of increasing the hostility, and at the same time the security, of his enemies at Rome. He always affected the greatest moderation; and his friends at Rome were instructed to propose a compromise to the senate, sufficiently equitable in appearance: provided Pompey retired to his province, and Cæsar were allowed to retain Cisalpine Gaul with two legions, they proposed in his name to disband the remainder of his army, and to resign the other part of his provinces. "Observe the dutiful citizen and good subject," said Cato, "how ready he is to quit the northern parts of Gaul, if you only put him in possession of Italy and the city: and how ready to accept of your voluntary submission, rather than employ your own army against you to enforce it."

The senate at last came to a vote on the following questions respecting the appointments of Cæsar and Pompey. On the first question, Whether Cæsar should disband his army? the *Ayes* were general throughout the house. The same question being put respecting Pompey, the *Noes* greatly prevailed. Mark Antony insisted that a third question should be put, viz. Whether both should dismiss their armies? On this question, three hundred and seventy *Ayes* appeared against twenty-two *Noes*.

Shortly after this, Cæsar received an order from the senate to detach a legion from his army to be employed in the Parthian war, in which Crassus had fallen, with the greater part of his army, some time before; and likewise to restore the legion which he had borrowed from Pompey: With both these requisitions he complied with seeming cheerfulness. In dismissing the soldiers of Pompey, he was, under pretence of gratitude for former services, most lavish in his caresses and his thanks; and, as an earnest of future favours, gave each man a gratuity of about 5*l.* of our money. Thus, whilst he parted with the men, he retained their affections; and sent them as a very dubious accession of strength to his enemy.

An immediate rupture was now unavoidable; and the consul Marcellus, the third of that name in the succession of consuls, being thwarted in all his measures by the tribunes, declared, in a fit of impatience, that he would put the exercise of his power into hands more likely to make it respected; and upon this he went and presented his sword to Pompey, bidding him employ it in the defence of his country.

Cæsar had now left the northern parts of Gaul, and took up his residence at Ravenna, the nearest point of his province to Italy: From this place he sent a letter to the senate, not couched in the most respectful terms, and complaining of their injustice in robbing him of the honours decreed to him by the Roman people. This letter was deemed an insult by the senate; and a resolution was framed, ordering Cæsar to dismiss his troops by a certain day, and, in case of disobedience, declaring him an enemy to the state. To this resolution the tribunes interposed their negative. Upon this it was moved, that the senate should put on mourning, as in a case of public calamity; this the tribunes also forbade. The members, however, of their own accord, appeared at their next meeting in mourning, and gave it in charge to the consuls, in conjunction with Pompey, *to provide, by every means in their power, for the safety of the state.*[*]

The tribunes, who had occasioned this measure, affecting to apprehend danger to their persons, disguised themselves in the habits of slaves, and, together with Curio, fled in the night to the camp of Cæsar. The consuls repaired to Pompey in the suburbs, and claimed his assistance in the discharge of their duty. Cæsar, upon hearing of these measures, called out his troops then at Ravenna, enumerated the injuries which he had received, depicted, in glowing colours, the injustice of his enemies, and exhorted his soldiers to support the honour of their general, under whom they had so long, so gloriously, and so successfully served their country. He was answered by a general acclamation from the ranks, that they were ready to avenge the injuries done to their general, and to the tribunes of the people. At this time Cæsar had but a small force on the side of Italy, and it was not supposed that he was in a situation immediately to commence hostile operations; and, so long as he did not bring any alarming force towards Rome, his enemies continued secure, and made no effectual provision to resist him; so that the seeming neglect with which he suffered himself to be taken, was probably a preconcerted measure, and the best preparation he could make for beginning the war. He had most to apprehend from Pompey's legions in Spain; and he had made the best disposition against them, by placing the strength of his army between the Pyrenees and the Alps.

On the very day in which he harangued his soldiers at Ravenna, he passed the Rubicon, the boundary between his province and Italy, by which he virtually declared war against the state. Plutarch, and others, have given us an account of the scruples and agitations which disturbed his mind on the passage of this famous stream; he himself makes no mention of any such scruples in recording this event, and, indeed, it is very unlikely that he should have had any, after the lengths he had gone. He who had held it as a maxim, *Nihil esse rempublicam, appellationem modo, sine corpore et specie;* and who had overleapt the most sacred laws which had been devised for the defence of the state, was not likely to feel compunction on crossing a trifling stream.

He immediately seized Ariminum, the first fortified town beyond the Rubicon. Here he again addressed his soldiers; presenting the tribunes to them in the same dress in which they had fled from Rome, "See," said he, "to what extremities persons vested with the sacred office of tribunes are reduced, for having supported their friends, and pleaded the cause of an injured army." Some advances were now made by Pompey, probably merely with the view of gaining time; these Cæsar knew well how to evade. Accordingly he was continually making offers of peace, that he might throw the odium of the war upon his enemies; whilst, at the same time, he was pushing his military operations with the utmost vigour. As fast as troops could march, he seized Pisaurum, Faunum, Auximum, Ancona, and every other place which was necessary to give him the command of the country, or to open his way to Rome.

Pompey appears to have been quite unprepared for these decisive measures of Cæsar; some of the senators sarcastically desired him *to stamp with his foot*, as he had formerly boasted that he could by this means raise an army to oppose Cæsar. He now informed the senate of the necessity of leaving Rome; and, though he did not avow his intentions, he had resolved on leaving Italy. His retreat damped the courage and the zeal of his followers; and, as soldiers seldom voluntarily choose the losing side, even the troops who had been raised to oppose Cæsar deserted to him, and greatly augmented his army. Rome was now open to him, but he esteemed the possession of it of no moment, till he should decide who was to be permanent master. He therefore marched in search of Pompey, who fled before him to Brundisium: he immediately invested the place, which Pompey defended only till he got his troops transported to Dyrrachium on the other side of the gulf.

Cæsar having made himself master of Italy in sixty days, now directed his course to Rome. He every where made the greatest ostentation of clemency, and gradually dissipated the fears which were generally entertained of another proscription. He found little, however, at Rome to gratify his feelings; the consuls and most respectable part of the senate had followed Pompey; and there was a general air of distrust and desolation. He had not even resolution to harangue the people, as he had once proposed; he avoided public view; and, having spent only a few days in Rome, he set out for Spain, where he expected the weight of the war, after having stript the public treasury of all the money which it contained. He was for a considerable time vigorously resisted in Spain by Afranius and Petreius, Pompey's lieutenants: with his usual ability and success, however, he at last prevailed, and the whole army was forced to surrender. With his usual policy he treated them with the greatest clemency, and gave them liberty to retire to whatever place they pleased. After the reduction of Spain, whilst he was engaged in the siege of Marseilles, he received intelligence that his party at Rome had procured a decree of the people, vesting him with the power of dictator. He hastened to Rome to take possession of his new dignity, which was of some consequence to him in his present circumstances, as he could then plead the appearance of legal authority for his proceedings. He staid only eleven days in Rome, and then marched after Pompey, who had collected a great force in Macedonia. He landed on the coast of Epirus, before Pompey had any notice of his approach. The latter, however, having the command of the sea, by means of his superior fleet, took possession of Dyrrhachium, where he could easily be supplied with provisions. Cæsar, with an inferior army, attempted to inclose him in his camp, and cut off all communication with the land; but, after incredible exertions of labour and of valour to accomplish this object, he was baffled, and in fact routed; and had Pompey known how to improve the advantage he had gained, there must then have been an end of Cæsar's fortunes. But Pompey, from the high character of Cæsar's men for steadiness and discipline, mistook their flight for a feint, and did not dare to pursue them. "This day," said Cæsar, "victory would have declared for the enemy, if they had had a general who knew how to conquer." He was so much distressed for want of provisions, that he was under the necessity of immediately retreating: Pompey pressed close upon his rear; but it was evidently the interest of the latter to avoid a battle, and not to give his enemy a chance of retrieving the advantages he had lost: and had Pompey been allowed to follow his own inclination, this was the plan which he intended to adopt; but his troops, flushed with their late victory, were continually demanding to be led against the enemy; and Cato alone, of all the officers and senators who accompanied him, seconded his plan for delay. Whilst his army was in this disposition, he came up with his enemy, who was encamped at Pharsalia. Cæsar did every thing in his power to provoke an engagement; but despairing at last of accomplishing his purpose, he was on the point of decamping, and had actually given the signal to march, when it was observed that Pompey's army had advanced considerably farther than usual. Cæsar exclaimed, "the time we have so long wished for is come; let us see how we are to acquit ourselves;" and immediately gave the signal for battle. The result was the complete defeat of Pompey's army, with the loss of 15,000 killed, and 24,000 prisoners, most of whom enlisted in the army of Cæsar, (see PHARSALIA.) Pompey fled almost alone into Egypt, having some claim on the gratitude of the Egyptian court. Cato, with the fleet and the remains of the army, steered his course for the Roman province of Africa, where, in consequence of the assistance of Juba, king of Numidia, the affairs of the republic still wore a flourishing aspect. Cæsar, in the mean time, instantly followed Pompey into Egypt: but this formidable enemy was now no longer in a situation to cause any disturbance,—he had been basely murdered; and Cæsar is said to have wept, and to have turned away his face, when Pompey's head was presented to him.

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[*] The charge to the consuls to take care, "Ne quid detrimenti respublica caperet," was only given in cases of the utmost emergency.

In Egypt, he engaged in a very idle and dangerous war, as is thought, chiefly at the instigation of Cleopatra, in whose society he forgot, for a considerable time, the stake for which he was contending, and the armies which were forming in Africa, to dispute with him that empire at which he aimed. After this foolish interlude he marched against Pharnaces, the son of Mithridates, who had hoped to regain his father's possessions, amidst the commotions which distracted the state. Cæsar made great ostentation of the facility with which he conquered this enemy; and to detract from the glory of Sylla and Pompey, who had triumphed over this prince's father, he said, "how cheap is fame, when obtained by fighting against such an enemy!" The trophies gained in this victory were distinguished in his triumph by labels bearing this inscription, *Veni*, *Vidi*, *Vici*. Cæsar now hastened to Italy, where Antony had been ruling in his absence, with the haughtiness and state of a despot. He gave orders for the veteran legions to embark for Africa, under the command of Sallust the historian, who had all along been devoted to his party. The troops, however, refused to obey; several of their officers were killed in a tumult, and Sallust escaped with difficulty: they marched straight to Rome, and Cæsar, contrary to the advice of his friends, presented himself to the mutinous soldiers. They demanded immediate dismission, and the reward of their past services. With his usual address, he confessed that their demand was highly reasonable, and should be instantly complied with. He addressed them by the appellation of *Quirites*, and said he was sensible that they had already done too much, and were unfit to contend with new dangers. We do not exactly know what mystery there is in this word; but it appears not to have been familiar to the ears of soldiers: for they immediately cried out, that they were no *Quirites*, but soldiers, willing to serve; and from the height of mutiny and disobedience, they proceeded, as is not unusual in such cases, to the extremes of submission. After a very difficult campaign in Africa, the forces of the republic were at last completely defeated; and Cato, the head and hope of the party, perceiving that all was lost, killed himself in despair. "I must envy this man," said Cæsar, "the splendour of his death, as he has refused me the honour of preserving his life."

He was now absolute master of the empire; and except in quelling a rising in Spain under the son of Pompey, was engaged in no other military enterprise. The senate and people at Rome now vied with each other in acts of servility, and in decreeing the most extravagant honours to the subverter of their liberties. Cæsar showed himself pleased with these demonstrations of submission; and, to make the yoke sit as easy as possible upon them, his administration was distinguished by the utmost liberality and magnificence. Instead of gladiators, he exhibited engagements between considerable parties of cavalry and infantry; he showed the manner of fighting with elephants, having forty of these animals trained for the purpose. In these combats, the parties being captives or malefactors condemned to die, exhibited all the efforts which could be made in real fight. He spread an awning of silk, a rare article at that time, over the public theatres, that under this delicate covering the spectators might enjoy the sights of bloodshed and horror, undisturbed by the rays of the sun: and, to complete this expensive magnificence, he entertained the people at a public feast, at which twenty thousand couches were placed for the guests.

This affectation of regal pomp, gave great disgust to the noble families at Rome; and Cæsar had shown himself to be fond not only of the state, but of the title of a king, which had been odious to the Roman people ever since the expulsion of the Tarquins. One of his emissaries, to suggest the propriety of bestowing this title, bound the head of one of his statues with a royal fillet. The tribunes affecting great zeal for the honour of Cæsar, sent the author of this act to prison. He was much displeased with this officious interposition of the tribunes, and hearing them called *Brutus's*, as restorers of the public liberty, he said, they were *Brutes* indeed, but took no farther notice of the matter.

A short time after this, some one in the assembly of the people saluted him with the title of king; but instead of acclamations, there was a general murmur of dislike: and he thought proper to discountenance this unseasonable flattery, by saying, that his name was *Cæsar*, and not *King*. Nobody doubted, however, that he now aspired to this title; and this opinion was still farther confirmed, when, on the 16th of February, at the *Lupercallia*, Antony, his chief confident, publicly offered him a crown. It was the custom in this festival for the first officers of the state, along with the principal nobility, to run naked through the streets, striking with thongs of undressed leather, all who happened to be within their reach. Even women presented themselves in this indecent ceremony, regarding a stroke of the thong as a sovereign cure for barrenness. Antony bore his part in this ceremony; and when he came opposite to Cæsar, who was seated on a gilded chair, and in his triumphal robes, he presented him with a royal crown, saying, "This crown the Roman people confer on Cæsar by my hands." Cæsar perceiving a general silence, pushed away the crown with his hand, upon which there was an universal shout of applause, a sufficient explanation of the popular feeling.

These obvious advances towards royalty gave great offence; whilst the facility of cutting off the tyrant encouraged a combination against his life. Cæsar had foolishly imagined that he would be able to uphold, by the voluntary submission of the people, that power which he had obtained by violence and blood. With this view he dismissed his guards, saying that he would rather die at once than live always afraid of death. He endeavoured, indeed, to reconcile the people to his government, by mildness, clemency, and munificence: but it was impossible to obliterate from their minds the remembrance of their former constitution, and of the way in which he had obtained his power. A conspiracy, therefore, was formed against his life, not by those who had suffered amidst the devastations occasioned by his ambition, but by some of his own particular friends, who were fired with the enthusiasm of liberty, and animated with the vain hopes of restoring the glories of the republic. At the head of this conspiracy were Caius Cassius, Marcus and Decimus Brutus, and Trebonius, with about sixty others. A meeting of the senate had been fixed to take place on the ides of March, and this was the time which the conspirators had chosen for the accomplishment of their design. Cæsar, however, being indisposed, had resolved not to attend the senate that day; but was induced to change his mind on the persuasion of Decimus Brutus. As he passed through the streets, a paper was put into his hands, which he was requested to read immediately, as it contained secrets of the utmost importance. He attempted to read it, but was prevented by the multitudes, who crowded round him with applications; and he still held it in his hand when he entered the senate.

Brutus and most of the conspirators had taken their places before the arrival of Cæsar. Cimber, one of the number, entered along with him, urging a petition in favour of his brother. Having received a denial, he took hold of his robe, as if to press the intreaty. "Nay, said Cæsar, this is violence." Upon this, Cimber flung back the gown from his shoulders, this being the signal agreed upon, and called aloud to strike. Casca aimed the first blow, and immediately the swords of all the conspirators gleamed around him, who, in their eagerness to reach his body, wounded one another. It is said that he made a stout resistance, till he saw Brutus strike, when muffling up his face in his mantle, he fell at the foot of Pompey's statue, pierced with three-and-twenty wounds. Cassius exclaimed, "There lies the worst of men!" Brutus, holding up his sword, still reeking with blood, called upon the senate, and upon Cicero by name, to judge of the transaction which had passed before them. But all who were not in the secret, being thunderstruck, and not knowing where the violence was to end, the senate broke up in horror and consternation: and the people expecting a general massacre, barred their doors, and prepared to defend every one his own habitation.

Thus fell this extraordinary man, after having been only about five months in the undisputed possession of that power which it had been the object of his life to obtain. Cicero, judging either from the general feeling, or from Cæsar's evident neglect of his own safety, had predicted his fall with a precision which might seem oracular. In writing to his friend Atticus, he says, *Jam intelliges id regnum vix semestre esse posse. Corruat iste necesse est, aut per adversarios, aut ipse per se; et id spero vivis nobis fore.*

Cæsar was unquestionably the most extraordinary character that has appeared in history, either in ancient or in modern times. Others have often risen from as small beginnings to a high degree of power, by improving the favourable incidents which pointed the way to distinction and honour. But Cæsar appears as the framer of his own fortune: In his history scarcely any thing occurs which we can call accidental; all the great objects which he accomplished were the result of accurate calculation, of a just knowledge of his own resources, and of profound observations on human nature. With regard to other individuals, we generally err in ascribing too much to preconcerted plans, and in diving too deep for the motives of their actions; but in the case of Cæsar, it is probable that we more frequently err in not perceiving the full extent of his schemes, or in not discovering those more minute and more complicated principles, which suggested the mode of conduct which he adopted. Viewing him merely as determined on subverting the liberties of his country, we see nothing in him to admire but his uncommon abilities. Catiline and others had desired to accomplish what he so successfully achieved; but they wanted that prudence, fortitude, and perseverance, which alone could ensure the success of their enterprise. Cæsar set out with the resolution of enslaving his country. He was not impelled to it by the necessity of his circumstances, nor by any sudden fit of passion. It was the settled, determined, purpose of his soul; and he adopted the most judicious measures to obtain his object His plan of ambition was cool, deliberate, and systematic: this was early observed by Cato, who used to say, *Unum ex omnibus Cæsarem ad evertendam rempublicam sobrium accessisse.* Sueton. *Vit. Cæs.*

But it would be an unfair representation of his character to stop with these observations: he possessed so many splendid endowments of genius, and so many amiable qualities of the heart, that we are at a loss whether we should most detest his ambition, or admire his learning, his taste, his humanity, his munificence. He had no propensity to cruelty, nor any thirst for blood: he had too little jealousy of mankind for his own safety, and less than might have been expected from his great penetration. Cicero, who detested his politics, and who celebrates the authors of his assassination as heroes and deliverers of their country, is nevertheless candid enough to acknowledge his extraordinary merit in other respects. He allows him to be a most admirable writer; a perfect master of the chastest latinity; an orator inferior to none, who had made eloquence the whole study of their lives. Had he lived, it is probable that his administration would have been the most splendid and the most liberal of any which have occurred in the annals of despotism. Give him but the title and honour of master, and he seemed willing to allow the utmost freedom of thinking and acting. Even after he had reached the zenith of his power, Cicero hesitated not to write an eulogium on Cato, who had always been Cæsar's most inveterate political enemy, and had killed himself rather than submit to his power: So far from shewing any resentment at this, he entered the lists with Cicero, on a field where it was thought few could contend with him, and published an examination of Cato's character, in a work entitled "Anticato;" in which he pointed out the blemishes of his character, and endeavoured to show that Cicero's praise of him was greatly exaggerated.

In his military character, it is probable that he never has been equalled. Like Alexander the Great, he often undertook enterprizes which would have been rash and ruinous in the hands of ordinary leaders, but the success of which was secured by the vast resources of his mind. Indeed the Grecian conqueror can scarcely stand a comparison with Cæsar. He over-ran nations sunk in luxury and effeminacy: Cæsar conquered the conquerors of the world, and triumphed over the most accomplished and skilful leaders. His Commentaries are not only specimens of the purest latinity, but they are a treasure of military science, and show the vigilance and skill continually exercised by this great commander.

We may perhaps even find some palliation for his ambition in the degenerate state of Roman manners. He saw that the republic was virtually dead; and that the sovereignty must soon be the prize of the man who had power or address to seize it. This made him less scrupulous about the measures which he employed; whilst the generosity of his nature taught him to believe, that he could render his usurpation a public benefit. In no hands could unlimited power more safely be lodged; for the world has never seen a more able nor a more amiable despot than Julius Cæsar. (*g*)

CÆSARIAN SECTION, or OPERATION. See MIDWIFERY.

CÆSIA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 189; and R. Brown's *Prodromus*, *Plant. Nov. Holland*, &c. p. 277.

CÆSULIA, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See BOTANY, p. 289.

CAFFA, or KAFFA, probably the *Theodosia* of the ancients,* is a seaport town of the Crimea, situated on a high mountain, which descends with a half circular slope towards the roadstead. From the beautiful bay of Caffa, the town appears to cover the southern side of it, and to rise like a vast theatre, with its numerous mosques and minarets, over all the hills which encircle that part of the bay. On the southern side of the bay stood the Genoese citadel: The walls, which are tolerably well preserved, are flanked with towers, and marked with several half effaced incriptions. The traces of the streets, within the inclosures, are still visible, and numerous subterraneous chambers, and spacious magazines, amid a promiscuous heap of ruins, assert the former splendour of this deserted city. The opposite, or northern side of the city, which was the residence of the Tartars, is the only part which is now inhabited. Between these two parts of the city, but rather towards the west, and elevated on the hills above them, stood that part of the town which was inhabited by the Armenians, and which is now a scene of ruins. Near the walls of the old Armenian fortress, and on the high ground above the Tartar city, are the ruins of a circular building, which Dr Clarke supposes to have been an ancient bath. On taking down a part of the stucco which loosely adhered to the wall, that celebrated traveller discovered a beautiful covering of coloured plaster, exactly similar to that which is found in Pompeia and Herculaneum. A few days before Dr Clarke's arrival, (July, 1800), a stone was discovered in the centre of the old pavement of this building. It was rudely sculptured in two parts, upon a kind of Cippus. In the upper part were two crowned heads, and the lower part contained a staircase leading to the mouth of a stone sepulchre. "I endeavoured," says Dr Clarke, "to prevail on the guides to follow the clue thus offered, and to search for the staircase so represented, below the spot on which the stone itself was found. This they refused to do." The other buildings, which are deserving of notice, and which are in the Tartar city, are some magnificent public baths and mosques in a ruinous condition, a few minarets, several shops, the Turkish coffee-house, an unfinished palace of the late Khan, and a large stone building at the entrance of the city, which was formerly a mint. Near this building there are some ruins, which Dr Clarke thinks may have belonged to the ancient Theodosia. The earliest inscription which he could find was not before the end of the 14th century. One of these, in the Armenian language, sculptured in relief, on a slab of white marble, was brought home by Dr Clarke, and is now in the vestibule of the university library of Cambridge. See Clarke's *Greek Marbles*, p. 3. No. viii. The following account of the devastations committed by the Russians, upon the public buildings of this city, is so peculiarly interesting and characteristic, that we are tempted to present it to our readers in Dr Clarke's own words:

"The melancholy devastation committed by the Russians, while it draws tears down the cheeks of the Tartars, and extorts many a sigh from the Anatolian Turks who resort to Caffa for commercial purposes, cannot fail to excite the indignation of every enlightened people. At Caffa, during the time we remained, the soldiers were allowed to overthrow the beautiful mosques, or to convert them into magazines, to pull down the minarets, tear up the public fountains, and to destroy all the public aqueducts, for the sake of a small quantity of lead which they were thereby enabled to obtain. While these works of destruction were going on, the officers were amusing themselves in beholding the mischief. Tall and stately minarets, whose lofty spires added much grace and dignity to the town, were daily levelled with the ground; which were of no other value to their destroyers than to supply a few soldiers with bullets,† or their officers with a dram. I was in a Turkish coffee-house at Caffa, when the principal minaret, one of the ancient and characteristic monuments of the country, to which the Russians had been some days employed in fixing blocks and ropes, came down with such violence that its fall shook every house in the place. The Turks, seated on divans, were all smoking, and when that is the case, an earthquake will scarcely rouse them; nevertheless, at this flagrant act of impiety and dishonour, they rose, breathing out deep and bitter curses against the enemies of their prophet. Even the Greeks, who were present, testified their anger by similar imprecations. One of them turning to me, and shrugging his shoulders, said, with a countenance of contempt and indignation, Σκὺθαι! SCYTHIANS! which I found afterwards to be a common term of reproach; for, though the Greeks profess the same religion as the Russians, they detest the latter as cordially as do the Turks or Tartars. The most lamentable part of the injury thus sustained, has been in the destruction of the conduits and public fountains, which conveyed, together with the purest water, from distant mountains, a source of health and comfort to the people. They first carry off the leaden pipes in order to make bullets; then they take down all the marble slabs and large stones for building materials, which they employ in the construction of barracks; lastly, they blow up the channels which convey water, because they say the water porters cannot earn a livelihood when there are public fountains. Some of these fountains were of great antiquity, and beautifully decorated with marble reservoirs, as well as with bas-reliefs and inscriptions. In all Mahometan countries, it is considered an act of piety to preserve and to adorn the public aqueducts. Works of that nature once appeared in almost every street of Caffa; some were public washing places; others poured out streams of water as clear as crystal for allaying the thirst of the inhabitants, and for ablutions prior to their going to the mosques. They were nearly all demolished when we arrived.

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* "As far as my own observations carry me," says Dr Clarke, "I have never yet been satisfied as to the fact that Theodosia and Caffa stood upon the same spot." *Travels*, vol. i. p 451. See the note.

† The Russian troops are obliged to provide themselves with lead.

The sculptured marbles of its ancient Grecian inhabitants had not shared a better fate. All that even Mahometans had spared of bas-reliefs, of inscriptions, or architectural pillars, were broken by the Russians, and sold as materials to construct their miserable barracks. We found the identical marbles, described by Oderico, broken and exposed for sale in the ruins of the old Genoese fortress. These were of peculiar interest, because they related to the history of the town. It was in vain that we solicited to become purchasers; the request was immediately denied by the general officers. Strangers, he said, are not permitted to take any thing out of the country."

The roadstead of Caffa is protected by a promontory from almost every wind, except those from the north and south west. Ships can anchor very near the shore in a slimy bottom. Its commerce is so inconsiderable, that a small number of merchant ships can scarcely find cargoes in it. Fishing is carried on to some extent in the bay of Caffa, and the sea of Azof affords a great quantity of sturgeons, the spawn of which, when salted, is called caviar, and forms a considerable article of trade.

The city of Caffa was so flourishing under the Genoese, that it obtained the name of Crim-Stambul, or the Constantinople of Crimea. It first came into their hands in A. D. 1226, and continued in their possession till the year 1475, when it was taken from them by Mahomet the Great. A considerable trade, however, was still carried on between Genoa and Caffa; and in 1672, when the city was visited by Sir John Chardin, 400 vessels arrived and cleared out in the space of forty days. After this the commerce of Caffa was entirely lost, and the Thracian Bosphorus shut against foreign vessels When Caffa, along with the rest of the Crimea, was ceded to Russia by the convention of 1783, Catherine restored the ancient name of Theodosia, and seemed desirous to promote its commercial interests. A quarantine was consequently established, and encouragement held out for merchants to settle in the town; but these attempts seem to have failed, as the town contained only about *fifty* families in 1800, when visited by Dr Clarke, and in some instances a house contained more than one family. In 1803, when this town was visited by Reuilly, the number of houses did not exceed 100,* which were chiefly inhabited by Greeks. In former times, Caffa contained 36,000 houses within its walls, and including the suburbs, not less than 44,000 houses. See Chardin's *Travels*; Reuilly's *Travels in the Crimea in* 1803, chap. vi.; but particularly Clarke's *Travels in various Countries of Europe, Asia, and Africa*, vol. i. chap. xix. p. 445. See also CRIMEA. (*o*)

CAFFRARIA, a country of Africa, extending across the southern part of the continent; and contained on the west between the 20th and 25th degree of S. Lat. and between the 24th and 32d degree of S. Lat. on the east. Some geographers have dilated these boundaries, and have applied the name to the whole country lying south of Cape Negro and the river Del Spiritu Santo, and reaching toward the north, between Lower Guinea and Monomatapa, as high as the equator. But the appellation Caffraria must be confined to that portion of country inhabited by the Caffres, from whom it takes its name; and as this people differ very widely in appearance, in disposition, and in manners, both from the negroes on the north, and the Hottentots on the south, the extent of their territories has been ascertained with considerable accuracy.

Of this country, however, our knowledge is as yet very defective. No travellers have penetrated far enough into the interior, so as to be enabled to give a correct description of its productions and inhabitants. Their excursions have been confined to some particular hordes; and from the manners and appearance of these have been drawn the general character of the nation. The Booshuanas, Barroloos, Damaras, Tambookies, and the inhabitants of Cafferland, who are particularly distinguished by the colonists of the Cape of Good Hope by the name of Caffres, are the only tribes of which we have any account: and it is to the latter of these that the descriptions of Paterson, Sparmann, Vaillant, and Barrow, chiefly refer.

This country towards the east is in many places extremely fertile. The mountains are covered with immense forests. The plains are clothed with a luxuriant herbage, and refreshed and fertilized by innumerable streams. But towards the west, in the country of the Damaras, it is a perfect desert. The inhabitants keep no kind of cattle. Their country, in fact, is so totally barren and sandy, that no cattle could exist upon it; and the whole subsistence of the tribe depends upon the exchanging of copper rings and beads for provisions with the Booshuanas on the east, and the Namaqua Hottentots on the south. These articles they themselves manufacture from the copper ore, which is found in great abundance, in a chain of mountains extending from the Orange river to the tropic. The climate is very variable, but it seldom rains, except in summer, when it is attended with thunder and lightning. On the banks of the Great Fish river, which is the boundary between the colony and Cafferland, Mr Barrow experienced a very remarkable variation in the temperature of the air, during the space of two days. When descending the heights towards the level of the river, the thermometer, which, on the preceding night, was as low as 52°, and which, at noon, had stood at 72°, in the course of an hour ascended to 102° in the shade, and to 106° when exposed to the direct rays of the sun. The wind, he observes, was due north, and remarkably strong, and the stream of air was so heated, that it was scarcely possible to bear exposure to it for any length of time. On the following day, however, on the same spot, and with the same wind, but less strong, the thermometer was no higher than 71°

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* In *all* the recent accounts of this town, it is said to contain four or five thousand houses.

The inhabitants of this country, though generally denominated Caffres, call themselves Koussis. They know no such word as Caffre; in fact, they are unable to pronounce it, as they have no sound for the letter R in their language. The name is derived from the Arabic *cafir*, signifying infidel. It was applied by the Arabs as a term of reproach to all who did not profess the religion of Islam; and the Portuguese, taking it in a general sense, have extended it to all those nations of Africa who seem to have no knowledge of a Deity. That the Caffres are not the original inhabitants of this country, appears perfectly evident, from their great dissimilarity, in almost every respect, to the other nations that surround them; and we cannot but agree with Mr Barrow, that they are of Arabic origin, though we may somewhat differ from that intelligent traveller in proving their affinity to that nation. They possess many features of resemblance, both in shape and in manners, to the nomadizing tribes of the Arabian desert. They have the same contour of visage, the same pastoral habits, and the same hospitable disposition; and what fixes their affinity still stronger, they practice the same rite of circumcision. But it becomes a question not undeserving of a solution, (though we do not pretend to give one altogether satisfactory,) how came they into their present insulated situation? Had they ever constituted a part of the armies of the Mahometan caliphs, which overran the northern shores of Africa, and extended their conquests along the eastern boundaries of this continent, we cannot suppose that they could have been so separated from their companions, as to forget the very name of the nation to which they originally belonged, and to retain no traces of that religion which they had laboured to propagate and maintain. We know that when Vasco de Gama visited this country, in the end of the 15th century, the Arabs had possession of all the coast from Cape Corientes to the Red Sea. It is consequently very improbable, that a people of the same language, of the same religion, and inhabiting the adjacent country, should have been so completely cut off from all communication with their brethren. Were we to form a conjecture upon this subject, we should date the emigration of this people prior to the final subjugation of Arabia to the Mahometan faith. The opposition which the religion of the impostor experienced from his countrymen, on his first appearance as a reformer; the difficulties which he afterwards met with in the prosecution of his schemes throughout the peninsula; and the circumstance that there are some of the Arab nations who, even to this day, have withstood the power of the Mahometans, and are still idolaters; induce us to suppose, that some of the independent tribes would prefer to forsake their country, rather than the religion of their fathers. These passing over into into Ethiopia, might wander southward in search of new settlements; and, driven before the swords of the conquering Moslems, might receive the appellation of *infidels*, which they still retain, and which might prevent all intercourse between them and their oppressors. Their adherence to the rite of circumcision cannot be urged, as is done by Mr Barrow, as any proof whatever of their having formerly professed the religion of Islam. This rite is not peculiar to that religion, but was practised by the descendents of Ishmael long before the appearance of Mahomet: and, according to Josephus, was performed, not on the eighth day, as was the custom of the Jews, but when about twelve or thirteen years old, which period is still observed both by the Mahometans and Caffres. This ceremony, however, the Caffre does not consider as a sacred institution, but merely as a custom handed down to him by his ancestors, and as a duty which he owes to their memory. It is the only exterior mark of religion which he seems to have retained; and if he possesses any religion at all, it is a religion without worship.

The appearance of the Caffre bespeaks him to have sprung from a race very superior to his neighbours the Hottentots of the Cape, or the negroes of Mozambique. He has neither the protruding cheek-bones and contracted chin of the one, nor the large broad face, flat nose, and thick lips of the other. The contour of his visage and head can scarcely be distinguished from that of an European; his countenance is open and manly, and generally overspread with a smile; his eyes are large and black, his teeth as pure as ivory, and his hair short and curled; his figure is tall, muscular, and elegant; and his carriage firm and erect. "A young man about twenty," says Mr Barrow, "of six feet ten inches high, was one of the finest figures that perhaps was ever created. He was a perfect Hercules; and a cast from his body would not have disgraced the pedestal of that deity in the Farnese palace." The women, however, are not of such a handsome make, being rather of low stature, and strong limbed; but they are sprightly, good humoured, and active; and their countenances are animated with dark sparkling eyes, and regular and beautiful white teeth. The same traveller, when describing a party of Caffre women, the first indeed which he had met with, observes, "Good temper, animation, and a cheerful turn of mind, beamed in all their countenances. We found them to be modest, without reserve; extremely curious, without being troublesome; lively, but not impudent; and sportive, without the least shadow of being lascivious." The Caffres also surpass their neighbours in the qualifications of their minds. They are mild, benevolent, and hospitable, but at the same time brave, and devoid of fear or suspicion; and in their manners have more the appearance of civilization than any other unlettered nation in the world.

Their language, though they retain not the smallest vestige of a written character, surpasses that of many nations who can boast of greater refinement and civilization. "In the enunciation," says Mr Barrow, "it is soft, fluent, and harmonious; has neither the monotonous mouthing of the savage, nor the nasal nor guttural sounds that prevail in almost all the European tongues; and is as different from that of the Hottentots, as the latter is from the English." The names of the mountains and rivers of this country, however, are all Hottentot, which is a presumptive proof that the Caffres are not the aborigines of these possessions which they now enjoy.

The habitations of these people are in general circular, and in the form of bee-hives, and are larger and more regular than those of the Hottentots. In Cafferland, the frame is constructed of wood, which is plastered both within and without with a kind of mortar made of yellow clay and the dung of cattle, and a neat covering of matting is wrought over the whole. Their temporary abodes, when wandering about with their cattle, are generally formed of the shrubbery of the woods, and consist of a few living twigs bent and interwoven into each other in the form of a parabola, and covered over with branches of trees and long grass.

The village which Mr Barrow visited, contained only from 40 to 50 huts; but among the **BOOSHUANAS** and

Barraloos, the towns are much more extensive and better built. (See these articles.) The Caffres rub their faces and bodies with a solution of red ochre, and the practice of *tatooing* is very general throughout the nation. The dress of the men consists chiefly of a long cloak made of calf skins, which in summer they throw entirely aside. They are fond of ornament, and their legs and arms are decorated with rings of ivory, or bracelets of copper and iron. Their necks are surrounded with glass beads, or a string of small bones, to which they give a most beautiful polish, and some of them wear porcupine quills stuck through the ears. The women have also a skin cloak reaching below the calf of the leg, which they wear in all seasons, and which is studded with brass buttons. The head is covered with a close leather cap, ornamented with beads, shells, and pieces of polished iron or copper; and from their neck, which is decorated with a vast variety and profusion of ornaments, is suspended the shell of a small land tortoise, in which they carry some red ochre, and a thin piece of leather to rub it upon their faces.

The Caffre is both a shepherd and a warrior, but he only assumes the latter character when the emergencies of his tribe call for his assistance. War is not with him an employment, which he prosecutes in order to satisfy his thirst for blood and plunder, and is never entered into, either for extension of territory or individual aggrandizement. It is only when compelled to take up arms by the aggression or injustice of a neighbouring horde, that he renounces for a time his peaceful habits, and enters into all the horrors and fatigues of war. His principal weapon is the *omkontoo*, or *hassagai*, as it is called by the Hottentots, from the name of the tree of which the shaft is formed. It is an iron spear, nearly a foot in length, fixed to a tapering shaft, about four feet long. This he throws with great address, and seldom fails of hitting his object if within fifty or sixty paces. His other weapon is the *keerie*, which he uses either in close engagement or at a distance. It is a kind of club about two feet and a half long, and at one end nearly three inches in diameter. He carries also an oval shield about four feet in length, made of the thickest part of a bullock's hide, upon which he receives the darts and arrows of the enemy. He disdains, however, to poison his weapons as is done by his neighbours the Bosjesmans and Hottentots, and considers it as unworthy both of his courage and his humanity: neither does he attack by surprise, but boldly opposes himself to his adversary in the open field. "Le Caffre," says Vaillant, "cherche toujours son ennemi face a face; il ne peut lancer sa hassagai, qu'il ne soit a decouvert; le Hottentot, au contraire, caché sous une roche, ou derriere un buisson, envoie la mort, sans s'exposer a la recevoir; l'un est le tigre perfide qui fond traitreusement sur la proie; l'autre est le lion genereux qui s'annonce, se montre attaque et perit, s'il n'est pas vainquer."

The Caffres are governed by chiefs, whose dignity, however, consists entirely in the respect and love of their subjects, and from whom they are distinguished by a brass chain, suspended on the left side of the head from a wreath of copper beads. But though completely independent of one another, yet one among these is generally acknowledged as superior to the rest, and is supposed to hold the sovereign power. This honour is hereditary, and can only be inherited by a son or a nephew, who succeed according to primogeniture; for, failing these, a king is chosen by the chiefs of the different hordes, which is frequently attended with dissensions and bloodshed. A chief has no power over the lives or properties of his subjects; but is amenable for every offence to the established laws of his horde or nation. These laws are extremely simple, and grounded entirely on natural principles. Premeditated murder is punished with instant death; but if a murder be committed in self-defence, in a quarrel, or by accident, a fine is paid to the relations of the deceased, as a compensation for their loss. This fine is either agreed to among themselves, or is settled by the chiefs and elders of the horde; and the amount is generally estimated by the value which the deceased bore in society. Restitution is the only punishment for theft; and they appear to be utterly unacquainted with the practice of imprisonment.

Cattle constitutes the sole wealth of the Caffres, and the tending and rearing of them are their principal employment. Some of their oxen are remarkably large, and resemble the Alderney cow; others are small and strong, not unlike the black cattle of the Highlands. The horns of their favourites are twisted into a variety of forms, particularly of those which are used for riding, for they have no horses. They manage their cattle with great regularity. Every movement is done by the sound of a whistle, made of bone or ivory, which is heard at a great distance, or by a similar noise made with the mouth, and which the animals seem perfectly to understand. In the morning they are dispersed to pasture by a particular signal; another collects them in the evening; and at a third the cows separate from the herd, and come forward to be milked; which operation, and also the management of the dairy, are entrusted entirely to the men. The drudgery and hard labour are left for the women, who not only look after the household affairs, but construct their habitations, break up the ground, sow the grain, and gather in the harvest. They are also employed in the manufacture of baskets for holding the milk, and of earthen pots in which they boil their food. These baskets, which are made of a species of *cyperus*, or strong reedy grass, are exceedingly neat, and the texture is so close, that they are capable of containing the thinnest fluid.

Agriculture is practised in this country, particularly in Cafferland, to a very limited extent; and though the soil requires very little preparation, and is so extremely fertile, that every vegetable substance, whether sown or planted, grows with great luxuriance, yet millet, and a large species of water melon, are their principal culinary plants. They cultivate also some tobacco and hemp, which are used only for smoking; and the effects of the last are said to be fully as narcotic as those of opium. But they appear to be more attached to a pastoral than an agricultural life,—a circumstance which must necessarily retard their progress in civilization. Towards the west, however, among the Booshuanas, agriculture seems to have arrived at considerable perfection; and the British commissioners, who were sent into that country in 1801, to procure a supply of draught oxen, passed through several large tracts of ground, that were laid out and cultivated like so many gardens; and in the neighbourhood of Leetakoo, they found several extensive fields, which were sown with a species of *holcus*. Though possessed of immense herds, and though much of their spare time is employed in hunting, yet they use very little animal food. They rarely kill any of their cattle, except as a token of hospitality, when visited by strangers; and they have no other domestic animals which can yield them subsistence, for in the whole Caffre country there is neither sheep, goats, pigs, nor poultry. They live chiefly upon milk, which they always use in a curdled state. To this they add a few gramineous roots, various kinds of berries, and the seeds of plants called by the natives Plantains,* which grow spontaneously in the woods, and on the banks of the rivers. They use also the pith of a certain species of palm, which they let lie for several days, until it becomes sour, and then bake it in the oven. Their ignorance of fermented or distilled liquors, and their temperate diets, exempt them from many disorders to which other savage nations are subject.

The commercial intercourse of the Caffres is confined to the Dutch farmers, and their eastern neighbours the Tambookies. The illicit trade with the former, consists entirely in the exchange of their cattle for pieces of iron, copper, glass-beads, and other trifling articles; but from the Tambookie nation they derive a more valuable commodity—their wives. Marriage among the Caffres is merely a bargain between the lover and the parents of his mistress. A previous courtship, and the daughter's consent, is seldom thought necessary. She considers herself the property of her father, and entirely at his disposal, and is neither surprised nor moved when informed of her fate. The common price of a wife is an ox, or a couple of cows; but the Tambookie wives are much dearer, as they are more esteemed, and are in general confined to the chiefs. Though polygamy be allowed, the custom of purchasing their wives prevents any inconvenience resulting from the practice of it, as few of the common people can afford to obtain more than one. The celebration of the marriage is attended with rejoicing and dancing, which sometimes lasts for weeks, according to the wealth of the parties. Their music and dancing, however, are both miserably bad. "A Caffre woman," says Mr Barrow, "is only serious when she dances; and at such times her eyes are constantly fixed on the ground, and her whole body seems to be thrown into convulsive motions."

The method of disposing of their dead differs from that of all their neighbours. The honours of sepulture are bestowed only on their chiefs, who are commonly interred very deep, in the places where their oxen stand during the night, or are covered over with stones, heaped up in the form of a cupola. The children are deposited in the ant-hills which have been excavated by the *myrmecophagi*, or ant-eaters; but all the rest are thrown out into an open ditch, which is common to the whole horde, and are there left without covering, to be devoured by the wolves. It is from this circumstance that the country abounds with these animals, as a Caffre, in consideration of their services in this respect, never attempts to destroy them. But however shocking and unnatural this practice may appear, yet the Caffres entertain a great respect for the memory of their deceased relations; and to swear by one of them is considered as an inviolable oath.

When Mr Barrow visited Cafferland in 1798, the supreme authority was held by a young chief called Gaika, who was of a most amiable disposition, and possessed a clear and vigorous understanding. He had been at war with his uncle Zambie, who, having acted as regent during the minority of his nephew, had refused to resign to him the government on his coming of age. In this war Zambie had been joined by a powerful chief to the northward; but Gaika, assisted by his father's friends, had been completely victorious, and had taken the usurper prisoner. This man, however, he treated with great lenity, restoring to him his wives and all his effects; and the only restriction that was imposed upon him, was to be always in the same village with the king. Gaika was well affected towards the British government at the Cape; and were the hostilities of the Dutch boors sufficiently repressed, there is no doubt but that the Caffre nation, under such a chief, would make a rapid advancement in civilization. See Barrow's *Account of Travels in Southern Africa*, vol. i. p. 166, &c.; and vol. ii. p. 112.; Le Vaillant *Voyage dans l'interieure de l'Afrique*, tom. ii. p. 200, &c.; Sparmann's *Voyage to the Cape of Good Hope*, vol. ii. p. 165.; Thunberg's *Travels in Europe, Africa, and Asia*, vol. i. and ii.; and Paterson's *Journies into the Country of the Hottentots and Caffraria*, p. 92, &c. (*p*)

CAGLIARI, or **Calari**, the capital of Sardinia, stands upon a commanding eminence, at the bottom of a capacious bay on the southern side of the island. The town rises from the sea, and, with its vicinity, has a very handsome appearance from the bay. It is defended by a castle and regular fortifications, and is divided into the upper town, which is improperly termed "The Castle," and the lower town, or suburbs. The former is walled round, and contains some tolerable buildings; but the latter, which lies upon the shore, is irregular and dirty, and chiefly inhabited by the poorer classes. Cagliari was the residence of a viceroy, the see of an archbishop, the place of assembly for the cortes or states general, and the seat of an university, founded in 1606. It contains a superb cathedral, five churches, and twenty convents; and had a royal audience, and several other tribunals.

This town possesses an excellent harbour, and is most conveniently situated for an extensive commerce. The want of proper encouragement, however, and burdensome restrictions, prevent the inhabitants from profiting by these advantages. They have little trade, and seem to be completely absorbed in indolence. The harbour is screened by a small island called Pietra Laida, and in the bay a numerous fleet may anchor in safety, in from three to fifteen fathoms of water. A small mole, capable of containing four galleys, lies opposite the low town. It is shut in towards the south by a wall rising about three feet above the sea, which serves as a rampart, and has a battery of eleven pieces of cannon.

Cagliari is supposed to have been first founded by the Carthaginians, and called Caralis. Upon the appearance of a British fleet under Sir John Leak in 1708, the inhabitants, fearing the destruction of their town, compelled the governor to surrender, after a few shots, when it was transferred to the Emperor Charles VI. It was, however, retaken by the Spaniards in 1717, and about two years after ceded to the house of Savoy. Population 30,000. N. Lat. 39° 25′, E. Long. 9° 16′. See Peuchet *Dictionnaire*, &c.; Azumi *Histoire Geographique, Politique, et Naturelle de la Sardaigne*, 1801; and *Della citta Cagliari, della citta Sassari Notizie compendiose sacre e profane*, 1780. (I.)

CAHORS, a town of France, anciently called *Divona*

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* The Heliconia Caffraria of Dr Thunberg, and the Strelitzia Reginæ of Willdenow. See Botany, p. 153.

Càdurci, and, before the revolution, the capital of Quercy, and a bishop's see, but now the chief place in the department of the Lot, is situated upon a peninsula formed by that river, about 143 leagues south from Paris. It is an irregular town, with narrow streets, built partly against the steep side of a hill, and defended with a thick wall and regular fortifications. The cathedral, which is ornamented with a large cupola, bears evident marks of antiquity; and there are still to be seen the ruins of a Roman amphitheatre and aqueduct. It has an academy and lyceum; but its university, which was established in 1332, was united to that of Thoulouse in 1751. Cahors has some manufactures of superfine and common drabs and ratteens. Its principal trade and wealth, however, are derived from the vineyards in the neighbourhood, which annually produce about 60,000 pipes of wine. This wine holds a high rank among the red wines of France, and great quantities of it are transported by the Lot and the Garone to Bourdeaux, from whence it is carried to Holland and England. This town carries on also a considerable traffic in hogs and walnut oil with Languedoc and Spain. It formerly had four annual fairs, each of which lasted four days; but it has now twelve, of one day each, which are held on the first day of every month, except in January and November, when the fair is kept on the third.

Cahors is governed by a prefect, a secretary-general, a receiver-general, a paymaster, and a director of the customs; and has a court of criminal and special justice, a tribunal of commerce, and a chamber of manufactures. Population 12,000. N. Lat. 44° 26′, E. Long. 1° 32′. See Peuchet *Dictionnaire*, &c.; and Tynna *Almanach du Commerce*, 1811. (L.)

CAIFA, Caipha or Heifa, Ephe, Kephe, Caphe, and Gabe, are different names which have been given to a sea-port town of Palestine, situated at the foot of Mount Carmel, and opposite to Acre, from which it is separated by the bay of Acre.

This place was formerly but a wretched village, constructed from the ruins of the ancient Porphyria, the remains of which may be still seen within less than a mile of Caifa. The ruins of the metropolitan church of Porphyria are still in existence; and it would appear that this place was the Sicammon of Ptolemy. The houses of Caifa are irregularly scattered, and are small and flat roofed; and, in summer, the inhabitants were accustomed to sleep in arbours, formed of the boughs of trees. Since Caifa came into the possession of the chief of Acre, a custom-house has been established, and the town has been defended by a citadel, and by walls towards the sea.

As the anchoring ground near Caifa is much superior to that at Acre, the corsairs formerly put in here to sell their prizes, which generally consisted of rice and slaves; and one of the Carmelites usually lent his aid as an interpreter between the pirates and the inhabitants. As the port of Acre has been choked up, and is not able to receive large ships, the vessels which trade with that place cast anchor in the bay of Acre, during the good months of May, June, July, August, and September; but during the other seven months of the year, they are under the necessity of loading and unloading the merchandise of Acre at Caifa, and of transporting it from one place to another in small barks. The town of Caifa exacts a certain tribute from travellers, who visit the church upon Mount Carmel; but the Europeans settled in the town are free from this exaction. The inhabitants are principally Mahometans, Catholics, and Greeks. Distance from Acre, 8 miles south-west. W. Long. 35° 10′, N. Lat. 32° 44′. See Acre and Carmel. (*j*)

CAIFONG. See Kaifong.

CAILLE, Nicholas Lewis de la, a celebrated French astronomer, was born at Rumigny, in the department of the Aisne, on the 15th of March 1713. The example of his father, who, after quitting the army, dedicated his leisure hours to mathematical and mechanical pursuits, excited in the mind of his son an ardent passion for the same studies. After having gone through the usual course at school, where he gave manifest indications of his future talents, he went to Paris in 1729, to perfect himself in the study of the classics and philosophy. Being intended for the church, La Caille was sent to study theology at the college of Lisieux; but his love for astronomy became so great, that he declined entering into priest's orders, lest his religious duties should be sacrificed to his ardour for science. At the early age of 18 La Caille lost his father, and was left without any means of support. The Duke de Bourbon, however, by whom his father had been patronised, generously extended the same kindness to the son and provided for all his wants. In 1736 he became acquainted with Bailly, by whom he was recommended to James Cassini, who obtained for him an appointment in the observatory; and by his valuable instructions, he acquired much additional knowledge of his favourite science, and obtained a thorough acquaintance with the difficult art of observation. During the year 1739, he was engaged, along with M. Cassini de Thury, the brother of his friend, in the general survey of France, an account of which was published in 1744, under the title of *Meridienne de l'Observatoire Royal de Paris verifiée*; and, in the same year, he was appointed to the professorship of mathematics in the college of Mazarine. La Caille was, on the 3d May, 1741, admitted a member of the Academy of Sciences, and he has enriched the memoirs of that learned body with many valuable communications. In 1743, he published his *Leçons de Mecanique*. His *Leçons Elementaire d'Astronomie*, which has been translated into English by Robertson, appeared in 1746; a second edition was published in 1755, and a third edition by La Lande in 1780. The *Leçons Elementaires d'Optique* of Caille were published at Paris in 1750. For the work entitled *L'Art de verifier les dates*, which was published at Paris in 1750, La Caille computed all the eclipses of the sun and moon from the commencement of the Christian æra. He likewise calculated a volume of ephemerides from 1745 to 1755, another from 1755 to 1764, and a third from 1765 to 1775. His *Tabulæ Solares quas e novissimis suis observationibus deduxit*, were published in 1758.

After having continued for several years to carry on his observations at the observatory of the Mazarine college, he proposed to the French court the project of visiting the Cape of Good Hope, for the purpose of settling the positions of the stars in the southern hemisphere. This plan having met with the approbation of the minister, he set out for the Cape on the 21st November, 1750; and during his residence at that settlement and in the isles of France and Bourbon, he observed the places of no fewer than 10,000 stars which are invisible in our latitude, and made a number of important observations on the parallaxes of the planets, the obliquity of the ecliptic, and astronomical refractions. Having thus completed the object of his voyage before the arrival of the vessel that was to carry him back to Europe, he resolved to employ the rest of his time in measuring a degree of the meridian. By means of a base of 38,802 feet, which was measured three times, he found that the distance between the Cape and a place called Klip-Fontyn, was 410,814 feet; and hence he obtained the length of a degree of the meridian, in the latitude of 33° 18′ south, to be about 342,240 Paris feet, or 57,040 toises. La Caille's instruments, however, were by no means excellent; and La Lande observes, that the toise which he made use of was too great.[*]

After an absence of four years, La Caille returned to France in 1754, and employed himself in preparing for publication the numerous observations which he made at the Cape. In 1757, he published his *Astronomiæ Fundamenta novissimis solis et stellarum observationibus stabilita.* In this valuable work, of which only a small impression was published, he gave the positions of 397 principal stars, which he had determined with the utmost exactness, by means of two instruments of six feet radius, at the observatory of the Mazarine College. This catalogue was the result of nearly ten years labour, and cost him more trouble than if he had determined the positions of 4000 in the common manner.[†] It was followed by another, containing the right ascension and declination of 1942 southern stars, selected from the 10,000 which he observed at the Cape.[‡] The right ascension and declinations of the other 8000 have not yet been calculated, but all the observations were published by Maraldi in 1763, in a work entitled *Cœlum Australe Stelliferum.* Between September 1760 and March 1762, La Caille determined the positions of 515 zodiacal stars; but in the midst of these observations, he fell a victim to his ardour for astronomy. In 1760 he had been attacked with a severe fit of the gout; but though it did not interrupt his observations, his health began gradually to decline, and being seized with a malignant fever on the 15th of March, he died on the 21st of March 1762. M. Bailly finished the calculations which La Caille had begun, and published the catalogue of 515 zodiacal stars, at the beginning of the ephemerides for 1765—1774, which had been calculated by La Caille. This catalogue is also incorporated with the catalogue in our article on Astronomy. It has been lately republished by Mr Vince, in his *Complete System of Astronomy*, vol. ii. p. 513.

In addition to these valuable catalogues, the science of astronomy owes many other obligations to La Caille. After comparing the numerous observations which he made on the parallaxes of the planets, with the observations of Bradley, Zanotti, Cassini, Gentil, Wargentin, Strommer, and Scheumark, he found that 26″.8, the mean of 27 results, was the horizontal parallax of Mars on the 14th September 1751, the day of his opposition to the sun; and that the horizontal parallax of the sun was 10¼″.[§] His memoir on *Astronomical refractions*, published in the Memoirs of the Academy for 1755, contains much valuable information on that difficult subject. It is founded on the comparison of the distances of 160 stars from the zeniths of Paris and the Cape, each of which were observed at least six times with very good instruments.

Beside the works which we have mentioned, La Caille published the *Memoirs of Father Feuille at the Canary Isles; the Journal of M. de Chazelle's Voyage to the Levant; the Astronomical observations of William, Landgrave of Hesse*, which the Duke de Laval had found at Cassel: and a new edition of Bouguer's *Essai d'Optique sur la Gradation de la Lumiere*, which appeared in 1760.

La Caille was elected a member of the Royal Societies of London and Gottingen, and of the Academies of Petersburgh, Berlin, Stockholm, and Bologna; and such was his industry and labour, that La Lande maintains that he made more observations and calculations, than all the astronomers together who lived at the same time with himself. La Caille had sketched out the plan of an extensive work, to be entitled, "The History of Astronomy through all ages, with a comparison of the ancient and modern observations, and the construction and use of the instruments employed in making them;" but he did not live to make any progress in the composition of it. Science might have long regretted this unfortunate event, had not the celebrated Bailly executed the same plan with such brilliant success.

The memoirs published by La Caille will be found in the Memoirs of the Academy for 1741, 1742, 1743, 1744, 1745, 1746, 1747, 1748, 1749, 1750, 1751, 1752, 1753, 1754, 1755, 1756, 1757, 1758, 1759, 1760, 1761, 1763. See the *Histoire de L'Academie*, 1762; *Connoissance des Mouvemens Celestes, pour* 1767; and the *Journal Historique du Voyage fait au Cap de Bonne Esperance*, par M. De la Caille, published at Paris in 1763 by M. Carlier. (*o*)

CAIRN, a heap of stones thrown together in a conical form. Cairns seem to differ from barrows, only in regard to the materials of which they are composed: they both seem to have been designed for the same purposes; and accidental circumstances directed the one to be constructed of stones, and the other of accumulated earth. In Scotland and Wales, cairns are more common, because the materials are every where to be found in abundance. In England, barrows are more frequent, because stones are not so easily procured for the construction of these monuments. In Egypt the two forms are sometimes found conjoined, as when a conical mound of earth is surmounted by a pyramid of bricks.

It is in vain that we attempt to trace the history of cairns, or to deduce their origin from any particular nation; they evidently originate in principles common to human nature, and were the first rude monuments of events which men were desirous to commemorate. Wherever we read of a pillar, or a stone set up as a memorial, we see the origin of the cairn, and the principle which gave rise to its construction: Gen. xxxi. 46; Josh. iv. 5. The durability of the substances, of which these monuments were composed, recommended them as memorials to more polished ages, and the splendid pillar and stupendous pyramid are only improvements and extensions of this simple structure.

From this view of the subject, it is evident that we do not mean to confine the uses of cairns, either to the purposes of religion or sepulture: they seem to have been applied to any event which appeared particularly worthy of commemoration. The Israelites raised a great heap of stones on the body of Achan, as a monument of perpetual infamy, Josh. vii. 26; and they also raised a heap of stones to celebrate their miraculous passage over the river Jordan. In the same manner, cairns are raised in Scotland to this day, in places where murders or suicides are committed; and there can be no doubt, that many of the ancient cairns are designed to celebrate events of more propritious omen.

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[*] See *Mem. Acad. Par.* 1751, p. 435; and *Astronomie* par La Lande, tom. iii. part. 2645, 2598.

[†] This catalogue is incorporated with the general catalogue of the fixed stars, which we have given in the article Astronomy, vol. ii.

[‡] This catalogue was published in the Memoirs of the French Academy for 1752, and has been republished in the *Tables de Berlin*, tom. iii. p. 183.

[§] Introduction to the *Ephemerides de* 1765—1774, p. 4.

As religion, however, even in the rudest states of society, has always deeply interested the feelings of men, we may naturally expect numerous monuments relating to this important subject. Connected with religion is the sepulture of the dead, an object of great importance in the estimation both of civilized and barbarous nations; and there can be no doubt that the cairns in Britain have often been consecrated to both these purposes. Without travelling far into the region of conjecture, we might claim for these humble monuments, the same origin and use which have been ascribed to the lofty pyramids of Egypt. Accordingly, some of our antiquarians have supposed the cairns to be relics of Druidical superstition, and originally dedicated to the worship of the sun; whilst others have contended, that they are to be considered merely as funeral monuments. The first opinion derives some support from a practice common in former times, of going round these cairns at particular periods, according to the course of the sun, when a favourable issue was desired to any event or undertaking; and of moving in an opposite direction, when vengeance and imprecations were denounced against obnoxious individuals: The second opinion derives confirmation, from the circumstance of urns and bones being generally found under these monuments. But the two opinions are not at all inconsistent. The place consecrated to religious uses, would naturally be considered as the most proper receptacle for the sacred reliques of the dead; whilst, on the other hand, the feelings which arise from contemplating the remains of our relations and friends, dispose the mind to devotion, and fit the place which contains them for the hallowed purposes of religion.

Cairns are to be found in almost every part of Scotland; and, in a great variety of instances, where their contents have been examined, they have been found to enclose urns, implements of war, ornaments of dress, &c. See *Statist. Account* passim; and Chalmer's *Caledonia*, vol. i.

A late traveller in America pretends that he has discovered some very singular monuments of this kind. He says, that, on a certain occasion, after removing a quantity of loose stones on the top of an eminence, he came at last to something resembling a tesselated pavement; beneath this he found the figure of a warrior, with a large serpent under his feet, all formed of coloured wood, which fell to pieces on endeavouring to lift it. He also found several rings of metal, which affords him an opportunity of speculating on the ancient civilization of America. See Ashe's *Travels*. We should regard the facts as very singular, were we perfectly satisfied as to their authenticity.*

There is a proverb among the Highlanders in Scotland, expressive of honour to the dead, "I will add a stone to your cairn."

Mr Pennant thus describes a large cairn in Wales. "The name of this place is taken from an immense *carnedd*, or heap of stones, surrounded with great upright stones in an adjacent field. It seems to have beneath it passages formed on the sides and tops with flat stones or flags. These were the repositories of the dead. Not that bones or urns are always discovered in them; for the founders, like those of the pyramids of Egypt, appear often to be disappointed in their hopes of having their reliques lodged in these laboured mausoleums. A few years ago, there were discovered under a carnedd, near the seat of Sir Nicholas Bayley, a passage three feet wide, four feet two or three inches high, and about nineteen feet and a half long, which led into a room about nine feet in diameter, and seven in height. The form was an irregular hexagon, and the sides composed of six rude slabs, one of which measured in its diagonal, eight feet nine inches. In the middle was an artless pillar of stone, four feet eight inches in circumference. This supported the roof, which consisted of one great stone, near ten feet in diameter. Along the sides of the room was, if I may be allowed the expression, a stone bench, on which were found human bones, which fell to dust almost at a touch: it is probable, that the bodies were originally placed on the bench. There are proofs that it was customary with the Gauls to place their dead in that form in cells; and that they added to the head of each body a stone weapon, which served as a pillow; but nothing of the kind was discovered in this sepulchre. The diameter of the incumbent *carnedd* is from ninety to a hundred feet. This seems to be that which Mr Rowland takes notice of in his *Mona antiqua.*" Pennant's *Tour in Wales*, vol. iii. See BARROWS. (*g*)

CAIRO, or, as it is often called, GRAND CAIRO, the chief city of Egypt, stands on the right or eastern bank of the Nile, a few leagues above the commencement of the Delta. The body of the town is distant about half a league from the river; and situated in the entrance to that immense plain, composed of alluvial soil, which here suddenly spreads out from the Nile, and comprehends the whole of Lower Egypt. Towards the east of Cairo stands the citadel, built on a lofty rock in the neighbourhood of a mountain called Mokaddem; about a mile to the west stand the ruins of Boulac, lately the flourishing port of Cairo; and at the same distance up the river is situated the populous suburb of Fostat, formerly the capital of all Egypt.

Cairo, "the queen of cities," and the boast and ornament of the East, was founded, according to the Oriental writers, in the tenth century of our æra, by Moaz, the first Fatemite caliph, who called it El Kahira, or victorious, in commemoration of his conquest of Egypt. This prince having soon after transferred his seat of empire from Barbary to Fostat, the Egyptian capital, made Cairo, in the vicinity, his place of residence, where he had a magnificent palace. After this period, if we may believe the same authorities, Cairo for the space of 200 years consisted of little more than gardens, barracks for soldiers, and the houses of a few grandees; till in the 13th century, the victorious Christains, who had invaded Egypt, gave a sudden impulse to its augmentation. Having taken Alexandria, and a number of other places, these formidable crusaders directed their march upon Fostat; but the Saracens, in the hope of disappointing their avarice, had already set their capital on fire, which continued to burn for fifty-four days. The town being thus reduced to ashes, the miserable population sought refuge in Cairo, which from that time became the chief city, and now began to be known by the title Masr, or capital, which formerly was applied to Fostat. The Europeans, not understanding this circumstance thoroughly, speak of an old and a new Cairo, instead of old and new Masr. Masr, or Mesr, seems a relic of Mizraim, the ancient name of Egypt.

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* We have some suspicion, that these *Travels* are of home manufacture, though the *Edinburgh Review* does not question their authenticity, nor express any doubts as to the facts above mentioned. On the contrary, it affirms such monuments to be common.†

† We confirm the above suspicion, and recommend to those who have read the vile falsehoods called *Ashe's Travels*, the perusal of Travels in the United States of America, in the years 1806 and 1807, and 1809, 1810 and 1811, by Mr John Melish. [HEMBEL, JUN.]

Soon after this event, the famous Saladin, elevated to the throne of the Egyptian Sultans, became a great benefactor to the new city; for he not only adorned it with mosques, an university, and other public edifices, but rendered it a place of great strength. He entirely surrounded Cairo with a wall, three leagues in circuit, which is still almost entire; built, or at least strengthened, the citadel, and beautified the town with a great number of gates, one or two of which are the admiration of travellers for their simple magnificence. About the beginning of the fifteenth century, Cairo was one of the richest and most flourishing cities in the world. It still preserved some remains of its ancient learning, it was the common storehouse of European and Asiatic merchandise, and its commerce extended from the pillars of Hercules to the remotest regions of India. The subsequent decay of this amazing city was occasioned by two concurrent causes,—the conquest of Egypt by the Turks, those merciless enemies of learning and of industry, and the discovery of a passage to India by the Cape of Good Hope. Among the interesting particulars connected with the history of Cairo, we cannot forbear reminding the reader, that here, in 1801, a British force took a whole army of French prisoners, and sent them back to their own country laden with the curses of an outraged population.

Cairo is still of prodigious extent, being, according to Volney, equal in size to Paris. The town itself, independently of its suburbs, is above an hour's walk in length, and its circumference more than nine miles. Its general figure is that of an immense crescent, winding round the bottom of the citadel. The general appearance of the capital from the Nile, is brilliant in the extreme. Sunk amidst the innumerable hillocks of rubbish, which have been accumulating in its vicinity for ages, the humbler buildings are concealed from the view; while the more lofty edifices, the citadel, and countless minarets, rising out of the gay foliage of the garden trees, present a noble specimen of Egyptian scenery. On a nearer approach, however, the illusion in a great measure vanishes. Its environs are disfigured by moulds of filth and rubbish, already mentioned; and the multitudes of tombs, together with the stench of the common sewers, excite disagreeable sensations. Like all oriental cities, which are still what they were five hundred years ago, you perceive on entering it but an irregular assemblage of dirty hovels, or rather masses of villages, crowded and huddled together in the greatest confusion. The streets are extremely crooked and narrow; and as they are not paved, the crowds of men, camels, horses, asses, and dogs, which are continually bustling through these narrow passes, keep up an incessant atmosphere of dust. It is a singular circumstance, that the streets are overrun with wild dogs, while clouds of hawks and pigeons are flying above. The principal streets of Cairo run generally from north to south, parallel to the great canal which intersects the town; and the lesser from east to west. These last, many of which have no thoroughfare, communicate with a main street, which extends the whole length of the town, and is lined on both sides with shops, crammed from top to bottom with all kinds of merchandise. The houses, crowding often into groups, large vacant spaces intervene; and these, together with the numerous courts and gardens included within the walls, are, during the inundation of the Nile, converted into lakes; so that what is covered with flowers and verdure in April, is in September sailed over in boats.

The houses of the poor are built of mud, or unburnt bricks dried in the sun, and are only one story high; those of the better sort of inhabitants are composed of a soft stone brought from Mount Mokaddem, and, contrary to the common practice in the East, consist of two and sometimes three stories, having all flat roofs, or terraces of stone or tiles. The houses here being wisely calculated for defence, the ground floor is either a shop, or has no windows towards the street. The upper windows, and those which look towards the court behind, are generally latticed; many are to be seen with paper, while some of the rich indulge in the luxury of glass. The houses of the beys and grandees are large and convenient structures, being in the form of a square, with a court or garden in the centre; around which are ranges of apartments for the different descriptions of the numerous inmates and domestics; but being surrounded with high dead walls, these edifices contribute nothing to the decoration of the streets. The gardens, which occupy the area of these courts, are well stored with trees of the most grateful and picturesque appearance, such as the palm and the sycamore; and these, together with the waterworks and basins, constructed of the finest marble, produce a feeling of coolness and refreshment extremely agreeable in this scorching climate.

Cairo abounds with large and sumptuous reservoirs for supplying passengers with water; and the number and elegance of its baths are no where surpassed. The okals, or warehouses, in which whole-sale commodities are kept, are remarkable for their size and strength; and are also convenient and clean—uncommon qualities in this country. The bazars, too, or retail market places, are very extensive buildings, containing many covered stalls, or shops, for the different commodities; for each kind of which there are appropriate quarters. But the greatest ornament of this city are its mosques, or giamees, of which there are upwards of three hundred within the walls. All these edifices being adorned with minarets or lofty steeples, of the lightest and most ornamented architecture, agreebly interrupt the uniformity of the flat-roofed houses, and are so numerous as actually to appear at a distance like the masts of ships in a crowded harbour. These minarets are surrounded, at a great elevation, with projecting galleries, in which stand the public criers, who announce the stated times of prayer prescribed by the Mahometan law. Upwards of eight hundred voices may be heard at once from these lofty stations. It is said that the jealous Mahometans compel these criers, by an oath, to keep their eyes shut while above, lest they should look into any of their harems; but that as a better precaution, they generally select blind persons for this office! Among this multitude of mosques, several are remarkable for their elegance and solidity. The most magnificent is the mosque of Sultan Hassan; next to it is the mouristan, a famous hospital for the insane, the sick, and the blind, where fourteen thousand persons are said to receive support at the public expence. Not far off is another noble structure, the mosque of flowers, in which there is an academy or college. This building, at the same time that it is a masterpiece of oriental decoration, and splendidly adorned in the interior with marble pillars and Persian carpets, is so remarkably strong that the Beys have sometimes mounted it with cannon, and dislodged the pacha from the citadel. Here is a considerable collection of manuscripts; but the only branches of learning taught are a sort of wretched theology, grammar, and astrology, in which the Mahometans are great believers. The interior of these mosques is in general fitted up with the greatest simplicity. The pavement is commonly covered with mats, seldom with carpeting; while the walls have scarcely any other ornaments than some passages of the Koran written in letters of gold, together with a vast number of plain lamps suspended in horizontal rows. In the middle of the city, the Greeks have a large church dedicated to St Nicholas. Here also the Armenians have one, and the Copts, or native Christians of the Eutychian sect, two. Their patriarchs, and that of Alexandria, of the Greek persuasion, have their residence in the street called Harte Room; and in another called Juwaria, resides the Archbishop of Mount Sinai, who, though he always lives at Cairo, is not a suffragan of the patriarch of Alexandria, but of that of Jerusalem. As the doors of these convents cannot be opened without paying an enormous tax to the Arabs, the entrance is by a window, to which you are hoisted up in a basket. The Jews also have a synagogue near the Greek church.

The citadel forms a noble object. It is situated on a rock of considerable elevation, and is about three miles in circumference: it is entered by two gates; you ascend to the higher by a steep approach, paved with large flag stones, through piles of ruined houses, lately destroyed in the frays between the Turks and Albanians, till you arrive at the foot of the walls, which are lofty and strong. As a fortress, however, the citadel is chiefly calculated, since the invention of gun-powder, to overawe the town, being commanded by Mount Mokaddem, a range of barren and naked rocks in its vicinity. The French engineers, according to Lord Valentia, wished to remedy this inconvenience by blowing up the commanding eminence, a design certainly practicable, though of great labour; but Bonaparte would not consent to a measure which had not originated with himself. All travellers agree in stating the view from the ramparts to be incomparably magnificent. You survey the whole of Grand Cairo, with all its gardens, fountains, squares, palaces, mosques, and minarets, stretched out at your feet, the ruins of Boulac, the populous town of Fostat, the grand aqueduct, the broad majestic stream of the Nile interspersed with verdant islands, the village of Geza on its opposite bank, and those eternal monuments of human skill and folly—the pyramids. Though at least twelve miles off, the courses of stones of which the pyramids are composed, together with the head of the sphinx rising out of the sand, are perfectly distinguishable by the naked eye; so enormously great are these masses!

The old and new citadels were formerly separate; but the French, having opened a communication between them, in a great measure converted them into one. All the objects of curiosity are contained in the new. This fortress, in which there is a very handsome *place d'armes*, is divided into three parts; the first contains the pacha's palace, the second the quarters of the Janissaries, and the third those of the Azabs. The palace has little to recommend it but its great size. Formerly it was splendidly ornamented, when occupied by the sovereigns of Egypt; but now that it is intrusted to the Turkish pachas, who are frequently changed, they take no interest in keeping in repair this vast structure They even no longer reside in the citadel, but in a large house in the town; using only a ruinous apartment in the palace as a divan, or council room. All the buildings in this quarter are in ruins, except those connected with its defence. The barracks of the Janissaries are very strong, and resemble an old European fortress with high walls and towers.

This citadel contains several splendid remains of antiquity. Near the quarter of the Azabs, is that truly wonderful specimen of ancient art, Joseph's well. This enormous pit, dug all the way through the solid rock, is sunk to the depth of 276 feet. At the mouth, it is an oblong square of twenty-four feet by eighteen; being eighty-four feet in circumference; which dimensions are regularly preserved to the depth of 146 feet from the surface. Here is a stage or floor in the well, from the middle of which, as it were, another well descends, of only fifteen feet by nine. This second shaft is continued 130 feet more, still through the rock, and terminates in the bed of gravel on which the mountain reclines, beneath the level of the Nile. A stair-case of gentle descent, cut in the rock, winds round the pit, with a thin partition left between it and the well, in which a few windows give a scanty light. In the lower division this precaution of a partition is omitted, and the descent is of course perilous in the extreme. The stage or floor in the middle of the well serves a valuable purpose. It contains a large basin, and affords sufficient space for three oxen, that here raise the water by means of a wheel; this water is poured from the string of small buckets connected with the wheel, into the basin already mentioned; from which it is again raised in the same way, by other oxen moving round the mouth of the well. This stupendous excavation, it is unnecessary to add, is attributed by the vulgar to the patriarch Joseph. Some have supposed it to be the work of Saladin, whose real name was Joseph, or Yussuf. For our own part, we are disposed to consider it as the work of a people much more scientific than the Saracens, and worthy of the same engineers who erected the pyramids. If this was really the site of the Egyptian Babylon, which is the opinion of many antiquaries, we cannot well suppose such a strong place to have been at the mercy of an enemy for water. Strabo, indeed, describes the water of Babylon as being raised by manual labour from the Nile. But this also is the case at Cairo; for though the water of the well probably proceeds from the Nile, yet percolating through sand impregnated with various saline substances, it is brackish; for which reason fresh water directly from the river is conveyed by an aqueduct to the foot of the citadel, whence it is raised to the castle by machinery. The tower of lights near Fostat, which Savary, after

Pococke, contends is the real Babylon, is totally dependent on the water of the Nile, and therefore could never have been a place of great strength; whereas, that of Cairo prefers indeed the river water, but has, in case of necessity, an abundant supply within itself, and a well which bears every mark of the remotest antiquity.

In the citadel is also Joseph's palace, an uncommonly fine building, exhibiting precious remains of its ancient magnificence. The great hall, so much celebrated by all travellers, and of which the reader will find a handsome engraving in Lord Valentia's *Travels*, is truly admirable. On four gigantic pillars of red granite, four elegant arches of Saracenic architecture recline, which formerly supported the roof. The capitals of the pillars are Egyptian, and belonged to a more ancient building. Another grand apartment is adorned with numerous pillars of granite, each of a single piece; all of these, except four, which have Corinthian capitals, are in the Egyptian style, and are evidently but the spoils of prior ages ingeniously enough combined by the industrious, though far inferior, hands of the Arabs. Opposite to this room is another, which commands a view of the whole city and neighbourhood. Here were woven and embroidered with gold, the rich green hangings, and the black covering of the Caaba, annually sent to Mecca by the grand signior. The walls of this apartment, now filled with ruins, were covered with figures in exquisite mosaic, part of which still remains; as were those of a neighbouring room, with handsome paintings, and the names of the ancient sovereigns of Egypt.

Another object of attention in the castle is the mint, the only one in all Egypt. Here the gold dust and silver ore, collected on account of government, in Africa and other places, are converted into coin; the gold into mahboobs, zingerlys, and funduklys, respectively of the value of 6s. 10½d., 7s. 7d., and 9s. 6d.; the silver into pieces of one, five, ten, fifteen, twenty, thirty, and forty paras; the value of the para being about three farthings of our money. The scandalous adulteration of these coins is a source of immense profit to the government: when the people murmur, some cannon are pointed at the town, which give instant currency to the money. On one side of the coin is the name of the reigning sultan, on the other is Masr, and the date. The machinery for striking the coin is similar to that employed in all the European mints before the invention of Mr Bolton. Instead of flattening the metals by means of rollers, they beat it out with hammers.

The number of tombs in the neighbourhood of Cairo is enormous. All the different races of men have distinct burying grounds. The English are buried with the Greeks. The tombs of the sultans and of the Mamelukes are of white marble; and these immense cemeteries, crowned with domes and minarets and gilt pavilions, are much more magnificent than the abodes of the living. This Necropolis, this city of the dead, is a little to the east of Cairo, without the walls.

About a mile to the west of the city, on the right bank of the Nile, stands the once flourishing and populous town of Boulac. This being the principal port of Cairo, it formerly presented a scene of perpetual bustle and activity. All the various commodities brought up from Rosetta and Damietta, as well as those from Upper Egypt, were brought in here in an infinite number of vessels of all descriptions; here was the capital custom-house of Egypt, together with an immense bazar, in which there was a perpetual market. The magazines of rice, salt, nitre, and several productions of Upper Egypt, were also established in this town, including the large granary of the sultan, whence he sent an annual supply of corn to the sacred cities of Mecca and Medina. This town, however, we understand, is now a melancholy monument of French barbarity. Having joined Cairo in an insurrection against these oppressors, this unfortunate place was entered by storm, given up to be pillaged for three days by the French soldiery, and finally burnt to the ground.

Fostat, otherwise called Masr-el-atik, or Old Masr, improperly by us called Old Cairo, though greatly decayed from its ancient grandeur, is still a considerable town, being half a league in extent. Its ruinous citadel, chiefly inhabited by Christians, contains a large convent of Greek monks, who used to accommodate with lodging and provisions, the numerous visitors from Cairo, attracted hither in the hot months by the salubrity of the air, the vicinity of the river, and the pleasant groves of the isle of Rhoda; but of late the cruel exactions of the Albanians have compelled these industrious fathers to shut up their convent, and retire to a smaller building. Fostat contains three custom-houses, for the trade of the Said, and the famous magazine called Joseph's Granary, where is still deposited the corn of the Thebais, destined for the provision of the troops. Here is the great church of St Macarius, in which the patriarch of the Copts is installed; the church of St Sergius contains a cavern held by the Christians in great veneration, as being the retreat of the holy family during their abode in Egypt.

At the entrance of this town commences the great aqueduct in a hexagonal building, each side of which is eighty feet wide, and one hundred high. Oxen go up a very gentle ascent, and turn a wheel, which raises water from the Nile to the top of the building. From a reservoir stationed here, it flows into the aqueduct, and is thus carried to another reservoir near the castle: there it is raised a second time by several wheels to the palace of the pacha, for the supply of the garrison. The aqueduct is a handsome structure of rustic work, supported by three hundred arches, and is said to have been built by the Arabs in the sixteenth century, in imitation of a similar work now in ruins, which supplied the citadel of Fostat.

Near this place, too, begins the great kalige or canal. Diverging from the Nile at a pretty sharp angle, it proceeds down towards Cairo, divides that city into two portions, filling in its passage all the ponds, reservoirs, and private canals of the place, and empties itself some leagues to the east in the Birque, a lake surrounded at present by the villas and pleasure-houses of the rich, and famous as the rendezvous of the pilgrims of Mecca. The extent between the Nile and the Birque forms but a small portion of this stupendous canal. It once communicated with the Red Sea; and vessels laden with the productions of Egypt traversed the burning desert. This work is ascribed by Savary, on the suspicious authority of the Arabian writers, to the caliphate of Omar, whose dominions at home being afflicted with famine, he is said to have commanded Amrou (who had just conquered Egypt, and burnt the library of Alexandria) to "dig a kalige," for the conveyance of grain. Hence this canal is styled by the Orientals, "The River of the Prince of the Faithful." But our best antiquaries ascribe it to the emperor Trajan, calling it by the name of Amnis Trajanus, a canal mentioned by Ptolemy; and indeed it appears to us infinitely more likely to be the work of a Roman emperor, than of a sanguinary horde of barbarians in the meridian heat of their religious fanaticism. This canal is certainly of great utility to Cairo and the neighbourhood, as it fills the reservoirs within and without the walls, and thus ensures a supply of water for household purposes, and for the irrigation of the lands. It is accordingly cleaned very carefully every year for the reception of the flood, and for some time is used as a street. This operation, however, being delayed as long as possible, to prevent a fresh accumulation of obstacles, the canal remains for six months after the recess of the water in a most horrible condition. The quantities of filth which it then daily accumulates, prevent its being dried by the heat of the sun within the city; and the detestable smell which is produced, during the hot season, from this putrid mass of stagnant water, soil, and dead fish, which are here left in great quantities by the Nile, infects the air, and, as some have conjectured, gives rise to the plague. It must be observed, however, that many of the best houses are built on this canal, where also is the quarter of the Europeans. During the influx of the inundation it is extremely pleasant, and presents a splendid exhibition of Egyptian fashion, being covered with parties of pleasure in their light skiffs and gilt barges, regaled with every species of music, and enjoying, in the midst of thousands of spectators, who at this time crowd their terraces and windows, the refreshing coolness of the recent flood.

Between Fostat, on the right bank of the Nile, and Geza, a small village on the opposite side, is the island of Rhoda, a pleasant spot in the middle of the river, about a mile in length, and entirely covered with large sycamore trees, and the most lovely verdure. The southern extremity of this island is fortified with bulwarks of the strongest masonry, to resist the force of the current. Over this breast-work is erected the building which contains the celebrated Nilometer, called Mekias, an accurate engraving of which the reader will find in Pococke. This water gauge, which has been visited by every traveller into Egypt, consists of a very superb marble pillar with a Corinthian capital, rising out of the centre of a basin, which has a communication with the Nile; and being accurately graduated to the top, exhibits the quantity of increase or diminution in the height of the river. Over the pillar is built a magnificent dome, supported by columns placed round the basin, and the whole is surrounded by the ruins of a great palace. It is unnecessary to remind the reader of the importance attached by the Egyptians to the annual overflowing of the Nile. As little or no rain falls in that country, the crops depend entirely on artificial irrigation; and when the waters of the Nile do not fill the canals and reservoirs, called birques, as well as deposit on the fields its fertilizing slime, vain are the labours of the husbandman. The Egyptians accordingly have, in all ages, assiduously watched its progress, and ascertained its quantity by a nilometer. The present mekias is above nine hundred years old. As soon as the river has begun to rise, its daily increase is watched by an officer, who continually transmits his report to Cairo, where it is proclaimed and received with the utmost eagerness. When it has risen to the desired height, about sixteen cubits, and the people have paid to the grand signior the tax for the use of the water, the pacha, attended by the beys and the whole of the court, goes in grand procession from Cairo, to be present at the opening of the great canal, which we have already described as intersecting that capital. Upon a signal given by the pacha, the workmen immediately open the mouth of the canal, which till now has been kept shut, and, as the water rushes into it, handfuls of silver are thrown into the stream by the nobility, by which means a most amusing aquatic scramble is produced among the populace, who dive for the money. At the same instant, multitudes of people in thousands of boats, and decked in their gayest attire, are eager to glide into the canal, and with the sound of vocal and instrumental music testify their joy on the occasion. The pacha, at the same time, going on board his magnificent bark, accompanied by the whole of his attendants in their barges, returns by water to Cairo in the same order of procession as he had gone by land. This ceremony of opening the canal, when the whole population of Cairo turn out, presents one of the most interesting spectacles to be met with in Egypt.

The population of Cairo is composed of a great many different races. The most numerous class are the Arabs, who constitute the body of the people. The other races are the Copts, who are Christians, and are the original people of the country, Albanians, Mamelukes, Turks, Jews, Syrians, Armenians, and Greek and Roman Catholic Christians. Besides these, there are Persians, Indians, Muggrebins, or western Africans, Abyssinians, and individuals of almost every nation under the sun, together with multitudes of negro slaves. To many of these races distinct quarters of the city are assigned, particularly to the Jews, Muggrebins, and Europeans The amount of this mixed and motley population it is impossible to ascertain, as the Mahometans neither keep registers, nor permit a numeration of the people. Some have stated it so high as 700,000, asserting that in one season 300,000 have been swept off by the plague; while others reduce it to 250,000 souls. Niebuhr justly contends, that the immense circuit of the town is no criterion of its population, containing as it does so many vacant spaces of canals, gardens, reservoirs, mosques, and public edifices, not to mention the lowness of the houses, which are, in general, but one story high; so that the population cannot by any means be supposed equal to that of a European city of the same extent. Browne, however, thinks it cannot be less than 300,000. The dress of the common people is simple, and adapted to the climate. The men wear a shirt of coarse calico, which hangs down to the knees; above this they have another larger and longer, of a blue, or rather black colour; and the addition of a broad leathern girdle completes the body dress. Their legs are bare, their feet sometimes protected by coarse shoes of untanned leather, while their heads are covered with a red cap, wound round with a piece of calico. The women are dressed much in the same style, but without the girdle and shoes; the most remarkable difference consisting in an ugly thick veil, which entirely covers the face and breast, with two holes in it, opposite the eyes, to see through. This piece of dress, together with the brown arms and ragged drapery of the Egyptian women, gives them somewhat of a hideous appearance in the eyes of a European. The people of condition, particularly those in any office, are remarkably gorgeous in their dress, and affect a good deal the Turkish costume. There is no place in the world where the traveller meets with a more remarkable contrast in point of condition than in Cairo; splendid palaces in the midst of mud hovels; horsemen clad in the most costly apparel, with their horses magnificently caparisoned, rushing through crowds of squalid wretches, emaciated with famine, and fluttering with rags.

The women of Cairo are upon the whole well formed, though not tall. Those of the upper ranks sometimes rival in point of complexion our European ladies; and this quality, in conjunction with fatness, constitutes the perfection of Egyptian beauty. They marry at the age of 14 or 15, and at 20 are already past their prime. The Coptic women are remarkable for their interesting features, black eyes, and genteel form. "The female Greeks born in Egypt," says Lord Valentia in his description of Cairo, "are pretty fair, and well made, when young; but childbirth destroys their figures by relaxation, and their bosoms become large and flaccid. Their head dress is Asiatic, and richly adorned with gold, pearls, and diamonds: their robes are of the same style, and consist of satins and velvets, faced or lined with fur. Unfortunately, in the same proportion in which the outside is adorned, the inside is neglected." The female love of finery is here so excessive, that, according to Niebuhr, the ladies retire, several times, from the same company, to appear again in a new dress, still more splendid than the former. The following sketch by Lord Valentia is no less descriptive of the Mahometan ladies of the Harem, than it is of the other ladies of Cairo. "In the morning I returned Mr Macardle's visit, and accepted an invitation from him to be present in the evening at an Egyptian dance. I went, but was not amused. The dancers were veiled, not from modesty, but to conceal their ugliness. They were somewhat in the manner of the Indian nautch girls, but never raised their voices to an artificial pitch. The dancers were infinitely too indecent even for description. Mrs Macardle, a pretty Greek, and a great number of ladies, were there; none of them seemed the least discomposed; but, on the contrary, laughed excessively: yet unquestionably this was by no means the effect of vice, but solely of habit, which had rendered the scene so familiar, that they did not perceive its impropriety, and even when asked, danced themselves in as indecent a manner. In the intervals the dancing girls went round, demanding money from each person." The dancing girls here alluded to, called *almeh*, are those who make a profession of dancing, singing, and relating tales for the amusement of company. Their gestures and songs are to a European disgusting in the extreme, and the frantic movements to which they are sometimes excited by their own ideas, with the help of brandy, make them no bad representatives of the ancient bacchantes. These are the governesses at Cairo, who instruct the wretched wives of the Mahometans, and teach them in their Harems, with great assiduity, those accomplishments in which they themselves are so infamously eminent. The lower orders also have their *almeh*, who are, if possible, still worse than the former.

Life, at Grand Cairo, partakes largely of that indolence which characterises the manners of warm climates. For nine months in the year, the body is oppressed by heat, and the mental faculties experience a corresponding languor. Hence it is, that you every where find sofas, cushions, and every convenience of repose: in every garden you have charming arbours and seats, but no walk; and tobacco, coffee, and sherbet, occupy the dreaming intervals of sleep. An Egyptian rises with the sun to enjoy the cool air of the morning; and having performed his ablutions and devotions, he receives his pipe and coffee, reclining indolently on his cushions. At the farther end of the apartment, his slaves, with their arms crossed, stand in silent attention before him, watching his eye, and anticipating his smallest wants. After breakfast, visitors arrive. His equals are placed beside himself, with their legs crossed; his inferiors, in a kneeling posture, sit upon their heels; whilst those of very high rank are seated on a raised sofa overlooking the company. Towards the end of the visit, a slave goes round with a silver plate, in which odoriferous essences are kept burning: each in his turn perfumes his beard, and sprinkles his head and hands with rose water. About noon dinner is announced; which is served in a large tray, and consists chiefly of rice and poultry, with melons, cucumbers, and other refreshing fruits. The guests, arranging themselves round the table, sit down on the carpet, and convey the morsels to their mouth with their fingers, the use of knives and forks being here unknown. To remedy this inconvenience, a slave, with a pitcher in one hand, and a bason in the other, is ready to present water, in which the guests occasionally dip their hands. After dinner, a rich Egyptian retires to his *harem*, where he passes some hours in sleep or amusement, among his women and children; afterwards, a short walk among the orange and sycamore trees, which grow in great luxuriance on the banks of the Nile, occupies part of his time in the cool of the evening; and about an hour after sunset, supper appears, consisting chiefly of rice and fruit.

The people here are extravagantly fond of the bath. The women, eagerly seizing on every moment of liberty which they can command, meet in parties twice a week at the baths, when they make an ostentatious display to each other of their finery. In Cairo is practised, in its greatest perfection, the bathing operation, called *massing:* this luxury consists in having your body rubbed all over by servants, who at the same time knead and press the limbs and joints till they crack, after being exposed to the hot or vapour bath. Europeans have described, in terms of rapture, the sensations which they have felt after this operation; though too frequent indulgence, we should suppose, must relax and debilitate the body. At Constantinople, and other oriental cities, the ladies have it in their power to take an airing in carriages; here, however, nothing of the kind is known; so that women of all ranks are obliged to ride asses, which are to be had in great numbers, saddled, bridled, and ready in the streets. A Jew or a Christian dares not ride a horse in this metropolis of pride, that being thought too great an honour for any but true believers; and if he do not alight from his ass immediately, on seeing a bey, or great man pass by, he is certain of being bastinadoed on the spot. The Christian and Jewish ladies, however, are exempted from this homage, out of regard for their sex.

One of the greatest sources of recreation here is the Nile, on which hundreds of elegant barks, with their long sail-yards and fantastic sails, are seen flying with great velocity in all directions. They are ingeniously carved and painted, and, being fitted up with fine cabins, carpeted over, afford a delightful shelter from the heat. Here, reclining in luxurious ease, the wealthy, sometimes accompanied by their whole *harems*, enjoy the delicious coolness of the water, and admire the ever-varying landscape presented to their eyes, as they pursue the frequent windings of this renowned river. Pedestrian parties are also seen frequently promenading along the banks, which are here adorned with a profusion of orange trees, the citron, and the pomegranate, planted without order, and growing high and tufted: these, together with the palm and the sycamore, towering above the rest in all the magnificence of their dark green foliage, afford an agreeable retreat from the dust and noise of the city, and from the fierce effulgence of an almost vertical sun.

The other amusements of Cairo are neither numerous nor interesting. Rope-dancers, fire-eaters, and tumblers of surprising agility, serve to amuse the populace. There are also to be seen some wretched actors, puppet-shows, and dancing monkies; these last being dressed, to make them the more ridiculous, in European habits, with their tails hanging down like swords, excite the merriment of the people at the expense of the Franks, who are held in the utmost contempt. Fire-works are sometimes displayed on public occasions. The principal games are polish drafts and chess.

Though the diseases of Cairo are common to all Egypt, they are perhaps aggravated by local circumstances. The mean annual heat here is 73°, and is not a little increased by the vicinity of mount Mokaddem, a dry naked rock which overlooks the city, and powerfully reflects the rays of the sun. This circumstance, together with the white glittering sand which every where covers the soil, produces defluxions in the eyes, often terminating in blindness. The other prevalent diseases are, a cutaneous eruption, proceeding, it is supposed, from the use of brackish water, but not much affecting the health; a virulent smallpox, malignant fevers, hydrocele, and venereal disorders. These last are said to be here rendered mild by the frequent use of the hot bath; though, at the same time, they are extremely obstinate, and often prove dangerous on removing to a colder climate. The frequency of hydrocele is ascribed to these, and to the relaxing qualities of the hot bath: Denon thinks it is often produced by drinking brandy distilled from figs, or the fruit of the sycamore tree. From the filth, poverty, and famine prevalent among the lower orders, the diseases of the place are certainly not a little exasperated; and to the same causes it is owing, that there are a greater number of deformed beggars, and emaciated sickly children, to be seen here than in any other city in the world. But of all the calamities and diseases to which Cairo is subject, the plague is undoubtedly the most terrible. It is not yet ascertained whether this scourge of the East originates in the filth of Cairo, or is imported from Constantinople. It generally rages in Egypt once in every four or five years, and continues only during the winter season, when it has been known to sweep off 1500 souls a-day from the population of Cairo alone. It is remarkable enough, that the Europeans, who reside on the very banks of the canal, are less subject to it than the natives. Their cleanliness, however, and the precautions which they adopt, sufficiently account for this circumstance: for no sooner does the plague appear, than they shut themselves up in their houses, often for several months, fumigating or washing the articles conveyed to them from without, and carefully avoiding the contact and near approach of persons exposed to the infection. It would appear, that the pestilential atmosphere possesses a considerable specific gravity, as it is not found to ascend so high as the tops of the houses; where the Europeans freely appear, and survey, in security, the havock of death in the streets.

In favourable seasons, provisions of most kinds are here very cheap; wine, sweet oil, and fuel, which is used only for cookery, being the produce of foreign countries, are rather dear. Onions still continue to be prized in this place, of which immense quantities are consumed raw by the poorer sort. The well-water of Egypt is for the most part brackish, as is also that which has stood for some time in the canals and reservoirs. On this account, the water drank at Cairo, except during the inundation, is brought in leathern bags from the Nile, on the backs of camels. Being commonly very muddy, it is poured into large earthen jars, previously coated on the inside with a preparation of bitter almonds, and, in the space of two hours, it becomes pure and limpid. Besides sherbet, which is used chiefly by the great, a fermented liquor, pleasant but soon spoiling, is here obtained from maize, millet, barley, or rice. The Christians distil for themselves, from dates, figs, or currants, a strong liquor known by the name of *araki*. The peculiar complexion of the diseases of a people, is produced, we venture to say, more by the qualities of their food, and their mode of living, than by climate.

The government of Cairo is vested in the bey of Masr, assisted by the mulla, or chief judge and priest, who is annually appointed by the grand seignior. The inferior judges, called cadis, amount, in this great city, to 200: their revenue consists in the value of the tenth part of the thing litigated. Besides these, there also are imams, or priests of the four sects, who exercise authority over their respective adherents. Notwithstanding the great extent of Cairo, its narrow and winding streets, and its barbarous population, fewer deeds of violence are committed here than in some European cities. For this security several causes may be assigned. Every calling here has a sheik, or chief, who keeps an eye on the members of his own fraternity; by which means, a police is established in every craft, and criminals are easily detected. The streets, too, having generally no thoroughfare, and being at night shut up with gates, prevent the possibility of escape. These gates are opened by a porter, who allows none to pass of a suspicious appearance; and, to insure respect, a guard of janissaries is within call, who, being liberally paid by the town, and never changed as long as they give satisfaction, have thus a powerful stimulus to discharge with fidelity their lucrative office. But, besides these preventive measures, the execution of justice is here prompt and terrible. The judges are constantly sitting. Officers, with a numerous posse of attendants, perambulate the streets by night and by day. The punishment of the bastinado is applied with unsparing vigour on the spot: and sometimes, when the wretched offenders are detected in the commission of great crimes, their heads are instantly struck off, and are received into a leathern bag carried about for that purpose. With such a form of government, it is obvious that the rulers must commit more crimes than the people.

Under the despotism of the Turks and Mamelukes, it were vain to look for excellence in arts or manufactures. In the furniture of houses, and decorations of silver and gold, there is much grandeur and barbaric parade; but throughout the whole, there reigns a poverty of invention, and a miserably bad taste. The most perfect of their manufactures is that of silk stuffs, which is, however, inferior to the European productions, and much higher priced. Their other manufactures are sugar, of a bad quality, obtained from the canes, which in some places cover the banks of the Nile; sal ammoniac, which is much in request; saltpetre, coarse gunpowder, glass lamps, red and yellow leather, and linen cloth of fine Egyptian flax. Their gun and pistol barrels, sword blades, hard ware, and mercery, are the produce of foreign manufacture. The carabines of the Mamelukes are English, and their swords Persian or Turkish. We might here mention the hatching of eggs by artificial warmth, a very ancient art, and at present retained principally at Cairo. The chickens are thought by some not to be so good as those hatched by incubation.

The commerce of Cairo with distant places, though much decayed within the last three centuries, is still very considerable. As the Metropolis of Egypt, the residence of the beys, the lawyers, and the wealthy, it consumes all the commodities of that country, or transmits them to the provincial districts; as a centre of circulation, it affords great facilities from its position. By the Nile, it corresponds with Upper Egypt and Abyssinia; by the Mediterranean, with Europe and the Turkish empire; by the Red Sea, with Arabia and India; and even by the deserts, it communicates with distant countries by means of numerous caravans. Damascus and Cairo are called "the two gates of Mecca," from the annual muster of pilgrims which takes place at these two cities, though we are uncertain what changes the Wachabees may have produced in this respect. Of these prodigious assemblages, the greater part are merchants, who avail themselves of this religious opportunity to conduct their traffic. Every year a great caravan from Abyssinia arrives in the neighbourhood of Cairo, on the banks of the Birque, or Lake of the Pilgrims, bringing from 1000 to 1200 negro slaves, great quantities of elephants teeth, ostrich feathers, gum, gold dust, parrots, and monkies; and here it remains till joined by another immense assemblage from western Africa. These pilgrims and merchants, some of them from the Senegal, proceeding along the coast of the Mediterranean, and collecting in their way those of Algiers, Tripoli, and Tunis, arrive through the desert at Alexandria, and from thence proceed to the general rendezvous at the Birque. This caravan has been known to exceed three thousand camels, laden with the merchandize of the West, consisting of oils, red caps, for which Tunis is famous, fine flannel, and many other commodities. This multitude being now incorporated with that from Ethiopia, and swelled by the crowds of Egypt, the whole set out for Mecca, under the orders of the sheik Bellet of Cairo. This high officer has in charge the presents of corn and money from the Grand Signior, together with the precious covering for the caaba. After a period of one hundred days, this great caravan, to the number, on some occasions, of 100,000 souls, return in a body to the same place with the choicest productions of the East. These consist principally of coffee, perfumes, gum-arabic, and other drugs, the produce of Yemen, with spices of Ceylon, shawls of Cashmire, and muslins of Surat and other parts of India. The same commodities are also brought by sea from Jedda to Suez, where near thirty vessels annually arrive in May. There are, besides, many smaller caravans to and from Cairo, particularly one in October, from the neighbourhood of Mount Sinai. These Arabs are extremely expert at adulterating their gum, which they convey to the amount of 700 quintals, for which reason they cannot be prevailed on to enter Cairo. They encamp at a distance, and dispose of their goods by barter, receiving arms, clothing, and other necessary articles in return. The small caravans from Damascus bring silk, cotton stuffs, and dried fruits. Immense quantities of tobacco, which has become one of the necessaries of life at Cairo, are constantly landing at Damietta by vessels from Latikia, which take in exchange cargoes of rice. The vessels from Constantinople, which also return with grain, bring clothing, wrought silks, furs, and arms, into the port of Alexandria; while those from Venice, Leghorn, and Marseilles, bring cloths, cochineal, Lyons stuffs and laces, iron, lead, grocery, together with Venetian sequins and German dollars, which are here imported at a great profit. All these articles are conveyed in lighters, called djerms, to Rosetta, whence they are sent up the Nile to Grand Cairo. Notwithstanding the excessive imposts, and the impolitic exactions of the Mahometans, the commerce of Cairo will appear, from the foregoing particulars, to be still considerable: it is said to have amounted in 1783 to between six and seven millions sterling. There can be no doubt but that the furious career of the Wachabees in Arabia, has considerably affected the external relations of Cairo; and from the bloody and exterminating affrays which have within the last year taken place there between the Turks and Beys, its commerce at present must be very precarious. Cairo stands in 30° 2′ 44″ N. Lat. and 31° 18′ 16″ E. Long. about 59 geographical miles west of Suez. See the *Travels* of Shaw, Pococke, Norden, Niebuhr, Savary, Volney, Bruce, Browne, Denon, Sonnini, Chateaubriand, Lord Valentia, and *The History of the Revolt of Ali Bey*. (E)

CAISSON. See BRIDGE, Vol. IV.

CAITHNESS, sometimes called the shire of Wick, is the most northern county of Scotland, and is bounded on the north by the Pentland Frith, which separates it from the islands of Orkney; on the east and south by the German ocean; and by the county of Sutherland on the west. Its form is an irregular triangle, measuring from north to south about 35 miles, and 22 from east to west, and containing 690 square miles. The coast is rocky, and indented with a number of bays, the principal of which are Scribister bay on the north west, and Rice bay on the east. Its promontories are Duncan's-bay-head, which is the north-east point of Caithness, and the extremest promontory in Britain; Sandside-head, Holborn-head, and Dunnet-head. The island of Stroma, lying in the Pentland Frith, now belongs to this county. Its property was formerly disputed by the Earls of Orkney and Caithness, but adjudged to the latter in consequence of an experiment, by which it was found that venomous animals would live in Stroma, whereas they die immediately when transported to the Orkneys.

The western part of the county is hilly, and even mountainous, and chiefly adapted for the rearing of cattle and sheep; but towards the east, it is almost completely level, and watered with several small rivers and lakes, but without a hill to shelter it from the piercing winds from the sea.

The climate is very cold, and more rainy than almost any other place on the eastern coast of Scotland. The rains generally prevail in spring and autumn, and sometimes do considerable damage to the crops. The snow, however, seldom lies long on the ground, from its proximity to the ocean; but the coldness of the weather during the spring months is a great bar to vegetation; and in the interior of the county, where the soil is rather tender, has a tendency to engender a species of vermin called *storee*, which destroy the young plants of barley and oats, by cutting the roots below the ground. The longest day in summer is about 18 hours; and the sun makes so small an arch below the horizon, that the inhabitants enjoy a continued twilight from the time he sets until he rises again.

The soil of Caithness, particularly in the Lowlands, is in general a mixture of clay, sand, and brown earth or loam, from six to fifteen inches deep, with a hard gravel, schistus, or horizontal rock, beneath, which has a tendency to keep it always wet and to obstruct vegetation, especially that of trees. In point of fertility, however, it is equal to any in the kingdom in proportion to its depth, and produces plentiful crops of barley and oats. The wheat husbandry has been attempted in some parts of the county, but on the whole has not been found a profitable crop, on account of the frequent and heavy rains which fall in October, when the farmer is putting the seed into the ground. Various kinds of green crops, however, are cultivated with success, such as turnips, clover, rye-grass, tares, cabbages, coleworts, &c.; and Mr Wright, in his Husbandry of North Britain, has observed, that the richest second growth of clover he had any where seen, was on a farm cultivated by Sir John Sinclair. Considerable improvements in agriculture have been made within the last thirty years, by the proprietors of this county. The wretched system of service, customs, and tithes, exacted by the landlord from the tenants, is now abolished, and the rent of the land is paid in grain or money. By the old mode of letting farms in Caithness, the farmer, besides the payment of a stated rent, was bound to cultivate a certain portion of land in the possession of the proprietor, by tilling, manuring, and sowing it in proper season; by cutting down, gathering in, and securing the crop in the barn-yard; and by manufacturing and carrying the produce to market. He was also to produce peats for fuel, straw-bags for carrying grain or meal, and hair-ropes for drawing the plough or for *tethers*; to keep a certain number of cattle for the landlord during the winter season; to pay vicarage of lamb, wool, &c.; and a certain number of fowls and eggs, which in the Highland district was converted into veal, kid, butter, and cheese; and on the sea-coast, into fish and oil. Sometimes even a certain quantity of spun lint and woollen yarn was annually exacted for the lady. The time and labour of the tenant were thus almost completely at the disposal of his landlord, which occasioned his own affairs to be either hurried or neglected. This practice, we are told, universally prevailed throughout the county, till only within thirty or forty years ago; and, according to Sir John Sinclair's view of the agriculture of this county, in 1794, out of its extent of 441,600 acres, only 93,600 could be accounted productive land, including in this, not only land in tillage, but also such meadows and pastures as were reckoned at all valuable.

But by the spirited and liberal exertions of the present landlords, cultivation has now assumed a very different aspect. Many of the waste lands have been brought under crop; and the miserable fences of turf which separated the waste from the arable lands, have given place to substantial stone dykes, with which some of the farms are now completely enclosed. Considerable improvements have also been made in the pasture farms by the substitution of sheep instead of small Highland cattle, which has greatly increased the value of property in this part of the country.

Great exertions have been made here for improving the roads, an object of essential importance to the success of agriculture; and a liberal aid has been obtained from government, on condition that the proprietors shall expend money to a proportional amount for this beneficial purpose. Though this county is very destitute of wood, it is probable that it was not always so, as considerable quantities of large fir and other trees have been been found in the morasses, and even in some places not far from the sea coast. The attempts, however, which have lately been made for raising plantations, have in general failed, and a few woods of birch is all that now remains, except in the Highland district, where there are some considerable forests. Those of Morravins and Berrydale, afford abundance of red deer and roebucks. Hares, rabbits, grouse, heathcocks, partridges, snipes, plover, and all kinds of game, are in great plenty throughout the county; also swans, wild geese, sea-ducks, wood-cocks, and birds called *snow fleets*, about the size of a sparrow, exceedingly fat and delicious, which are very numerous in winter, but always take their departure in April. Prodigious quantities of scarfs, marrots, fraiks, and other sea fowl, hatch in the rocks of Duncan's Bay and Stroma, whose eggs and young, during the season, supply many of the inhabitants with food. The rivers and lakes abound with trout, salmon, and eels; and Mr Pennant informs us, that at Thurso, 2500 salmon were once taken at one tide. Great numbers of seals are killed on this coast in the caverns that open into the sea. These caverns are narrow at the mouth, but in the inside lofty and spacious, and run some hundred yards under ground. The seal hunters enter them in small boats, and lighting torches as soon as they land, with loud shouts alarm the animals, which they kill with clubs as they attempt to pass. This, however, is rather a hazardous employment; for should the wind blow hard from the sea, these adventurers are inevitably lost.

The black cattle, which were formerly sent from Caithness to the south, amounted in some years to nearly 20,000; but this number has of late been very considerably diminished by the introduction of sheep farming into the upper districts of the county. The swine, which are reared here in great numbers, are of a small breed, have long erect ears, and most savage tusks; and though the native Highlanders abhor the flesh of this animal, yet they have always abounded in the lower part of the county. The chief manufactures of Caithness are linen, yarn and leather. A considerable herring fishery was formerly carried on in the summer months, in which it is calculated that from six to fourteen thousand barrels were annually taken; and it might have become an important branch of industry and commerce, had not the detention of the bounties in 1792 given it a fatal check, and ruined some of the adventurers.

Small veins of iron and lead ores have been discovered in this county, but not in such circumstances as to induce the proprietors to work them. Considerable quantities of white mundick, and a slender vein of yellow mundick; also a regular vein of heavy spar, mixed with lead and crystals, three feet in breadth, have been found near Thurso. A copper mine was once begun to be wrought near the old castle of Wick, but was soon afterwards dropped. There are plenty of whinstone, granite, and free-stone; likewise limestone and marl. Various attempts have been made for the discovery of coal, but though these have been conducted by persons well skilled in the business, and long persevered in, they have hitherto proved unsuccessful. A mineral, resembling this substance, has indeed been found near the surface, which seems to be an earthy substance, impregnated with volatile inflammable matter. It emits a hot vivid flame when burning, but without much dissolution of parts, or diminution of size, after it becomes extinct.

Among the antiquities of this county are to be found a variety of singular structures, called Picts houses. They are generally of a circular form, rising into the shape of a cone, with its top somewhat blunted, and the walls of the larger kind are nine or ten feet in thickness, and surrounded by a broad deep ditch, and a sort of rampart. These buildings are usually placed on the brinks of precipitous rocks, and in the skirts of sandy bays; and often stretch from one headland to another, evidently so arranged as to communicate with each other. Besides these are John o' Groat's house, whose traditional history is so well known; and the castles of Achaistal, Berrydale, Braal, Dirlet, and Lochmore.

The language spoken by the people of Caithness has always been the same as that of the south of Scotland, except among the hills on the borders of Sutherland, where the Gaelic is used. The names of many of their places are evidently Norwegian, as Ulbster, Stempster, Bindster, Scrabster, Bilbster, and several others; the terminating syllable *ster*, signifying in that language an estate.

Caithness sends a member to parliament alternately with the shire of Bute. Its population in 1794 was 24,802; and in 1801, 22,609; of whom 10,183 were males, and 12,426 females. See Pennant's *Tour in Scotland; Beauties of Scotland*, vol. iv. and v.; Sir John Sinclair's *General View of the Agriculture of the Northern Counties and Islands of Scotland.* (L)

CALABRIA, a province of Italy, which forms the most southern part of the kingdom of Naples, is bounded on the north by Basilicata, and the gulf of Taranto; by the Ionian sea on the east; and on the south and west by the Mediterranean and the straits of Messina, which separate it from Sicily. This peninsula is divided into Calabria Ultra, and Calabria Citra. The extent of the former is estimated, by Mr Swinburne, at nearly 1,521,302 English acres, and that of the other at 1,284,370; and their united population at 775,722 inhabitants. This country is rather mountainous, but the vallies with which it is interspersed are rich and fertile, and watered with numerous rivers. No country abounds more in towns and villages, has a greater variety of culture, and is covered with finer forests than Calabria. It has a very picturesque appearance. The form of its mountains differ from those of most other countries. They are seldom of a pointed or conical shape, but almost always round; and though some modern travellers have asserted that they are of volcanic origin, yet no traces of lava are to be found in their neighbourhood. They appear to consist, for the most part, of chalk and argil; and contain pyrites, asbestos, spar, quartz, granite, marble, and different kinds of sand, sometimes mingled without order, and sometimes ranged in regular strata.

Its principal rivers are the Coscile, Crathis, Trionto, Nieto, Tacina, Alli, Alaro, Abis, and Angilota. The Coscile is the Sybaris of the ancients, whose waters being strongly impregnated with mephitic gas, were supposed very injurious to cattle, on account of exciting dangerous sneezings and convulsions. The Crathis rises in the mountains south of Cosenza, and passing that city and Bisignano, joins its waters with the Coscile at the site of the ancient town of Sybaris, and falls into the Ionian sea. This river is broad, clear, and rapid, often inundating its banks, and destroying the neighbouring districts; and in 1629, it is said to have suddenly risen 20 palmes. According to Strabo, the waters of the Crathis had the property of tinging of a fair or yellow colour, the hair of all those who bathed in it; and that they were also very efficacious in the cure of several diseases.* The same tradition is preserved, and it may have arisen from the yellow appearance which this river still retains.

The climate of Calabria, which in some places is among the finest in the world, is in several of the most fertile districts very insalubrious, on account of the inundations of the rivers, which being allowed to roll their floods unrestrained over the low and neglected fields, leave, as they shrink back into their channels, black and stinking swamps, which poison with their noxious vapours the whole region around. But by a little industry and management, these bad effects might easily be counteracted, and these rivers, which at present disseminate the seeds of pestilence and disease, might be made to convey freshness and fertility to well tilled thirsty fields.

The soil of Calabria is very unequal, changing from a rich and mellow loam to a cold and wet gravel. Many of the mountains are nothing but bare and barren rocks, while others are covered with majestic oaks, and the sloping sides of some of the hills are embellished with fruit trees of every description: such as vines, figs, oranges, lemons, citrons, olives, mulberries, chesnuts, and almonds. The extensive forest of Sila, celebrated by Virgil in the 12th book of his *Æneid*, v. 715, reaches from above Cosenza on the north to Catanzaro on the gulf of Squillace, and covers a surface of nearly 400 square miles. The ancients, however, comprehended, under the name of Sila, the whole forest extending along the chain of mountains as far as Reggio, which Strabo estimates at about 700 stadia, above a hundred British miles in length. This forest abounds with fir and other resinous trees, which annually afford immense quantities of pitch, rosin, and turpentine. It belongs exclusively to the king; and the inhabitants of the country are prohibited, under tho severest penalties, even the confiscation of their property, from cutting down the trees. Above 400 persons are constantly employed in gathering and preparing the resinous substance; and its annual produce is nearly 11,000 *cantares* of pitch and rosin. The white pitch is the most valuable, but also the most scarce; seldom exceeding 75 *cantares*, or 22,688 ℔.; while the black pitch affords 10,000 *cantares*, or 2,777,500 ℔. The pitch of Sila is highly extolled by Strabo and Pliny,† as being very rich and resinous, and also, as being of great utility in medicine. It is still very much esteemed, and great quantities of it are annually exported to Sicily, Genoa, and Venice. The lower parts of the mountains abound with the *ornus*, a small leaved flowering manna ash, which grows spontaneously, and without any culture. All the manna belongs to the king, and the gathering of it is entrusted to the feudal lords, who receive for every man employed five carlini a day, two of which they keep to themselves. During the manna harvest, which generally lasts four or five weeks, every peasant who is called upon is compelled to abandon his own employment to assist in the work. The manna is extracted by making a horizontal incision in the bark of the tree, about half an inch deep, and inclining a little upwards; a small maple leaf is then fixed into the wound, from which the manna in its liquid state drops into the large leaves of Indian figs, which are placed at the foot of the tree instead of basins. Some kinds of manna, however, ooze out from the bark of the tree without any incision. This is very limpid and transparent, and crystallizes in little balls on the surface. It is preferred to the other kind of manna, but is very scarce, and sells in general very high. The gatherers are allowed to eat as much as they please in the woods, but if the smallest quantity of the juice is found in their houses, they are severely punished, and sometimes even incur the penalty of death. Many of the vallies are covered with the most luxuriant pasturage, upon which are fed numerous flocks of sheep, which form the principal wealth of the northern part of the province. Their wool is esteemed equal to that of Spain. It is strong and curled, and is very much employed in the manufactories of Venice. The cultivation of this country, however, is most miserably neglected. Every exertion is paralyzed by the hand of power. The peasant sees no amelioration to his condition from his efforts, and is discouraged, from the apprehension, that increasing activity and produce on his part would only expose him to an additional weight of taxes and oppression. "The husbandry of this province," says Mr Swinburne, "is slovenly, and the skill in gardening very superficial. Both betray a want of emulation and intelligence. Climate and soil do more than half the work, and the hand of dispirited man is sluggishly applied to the task; partial Nature empties the horn of plenty on his head; but, from many fatal causes, her bounty contributes little to his welfare; whilst we see, in more northern and less happy regions, the active enterprising labourer able to extort favours from her, and with the least gaudy of her riches raise himself to comfort and independence." The Calabrian farmer, instead of manuring and cleaning his ground, thinks he does well if he ceases to plough it for two or three years, and leaves the pasturage to make its way through the rank weeds which surround it. In some districts, the common course of husbandry is to take a crop of wheat, and then let the field lie fallow for two years. The mode of letting farms in this country is also a complete obstruction to every kind of improvement. In all the baronial and ecclesiastical estates, a lease of only two years, loaded with many clauses and restrictions, is allowed; and the term is extended by the plebeian landlords to six years. Some of the barons are not content with a short lease and an exorbitant rent; but they encroach upon the commons and cultivated grounds for the sake of extending their chase; and thus the poor peasants have sometimes neither room nor opportunity to raise sufficient food for their support. On the eastern part of the peninsula, however, the state of agriculture is much better, and consequently the ground produces much finer crops. The low lands are extremely rich in herbage, producing spontaneously rich crops of sainfoin; but half of the grass is suffered to rot in the ground for want of cattle to consume it.

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* Lib. vi. p. 404

† Strabo, lib. xxi. Plin. libs. xiv. xvi. and xxiv.

The fertile plains around Reggio appear like one rich and delicious garden, shaded by groves and avenues of poplars and mulberry trees, and divided by hedges of pomegranates, inclosing vineyards and orchards of various kinds of aromatic fruit. All sorts of vegetables abound under their shade, and copious streams distribute life and vigour through these delightful fields. Hemp is the principal production of this district, as being the most lucrative; and the essence of citron, orange, and bergamot, of which not less than 100,000 quarts are annually exported. affords them a considerable article of traffic with the French and Genoese. Great quantities of oranges are also exported from the environs of Rossano, in Calabria Citra, to Taranto and Gallipoli. But the principal article of Calabrian commerce is silk, and it is said that silk worms were first introduced into this country by Roger, king of the two Sicilies; though, according to Procopius. they had been brought into Italy in the time of Justinian. This new branch of industry increased so rapidly, that, in the 16th century, the produce of Calabrian silk exceeded that of all the rest of Italy, and amounted to 300,000 crowns; when a duty of five grana for every pound was imposed upon it by Charles V. in 1542. This imposition was afterwards gradually augmented, till, in the 17th century, it paid 36 grana per pound; which yielded annually to the treasury of Naples nearly 400,000 ducats. The quantity of silk obtained was estimated at three millions of pounds; which, after deducting all expences, brought into the country three millions of ducats. But this advantageous commerce has of late years very much fallen off, and, indeed, must necessarily decrease, on account of the extortion and vexatious imposition of the government. All the silk pods must be carried to the public cauldrons, where they pay a duty of four carlini a pound for boiling and winding off. Forty-two grana and a half are then exacted for every pound of marketable silk; and one grana a pound for the refuse and unprofitable pods; and, to complete the measure of their hardships, two carlini, or twenty grana, must be annually paid for every mulberry tree which they possess. All the profits are thus eaten up by these odious exactions; and the farmers have been so discouraged, that many hundred of valuable trees have been cut down to save the duty. The peasant can have no interest in the extension or improvement of this manufacture. New improvements only draw upon him new burdens; and, consequently, he looks upon the trade with indifference, and would rather allow it to perish than exert himself for its revival. From such causes the quantity has been reduced to less than one-third of its former product; and it is reckoned, that not above 800,000 pounds of raw silk are now annually exported to Naples from this province. The inferior sort brings 18 carlini per pound, and the best silk 25 carlini; so that the mean price may be estimated at 20 carlini, or two ducats of Naples. The principal manufactories of silk in Calabria are at Monteleone, Reggio, and Catanzaro; that of the latter city is the most important. The other manufactures and exports of Calabria are, silk, woollen and cotton stuffs, iron and earthen ware, hides, honey, and wine. Calabria possesses some very valuable mines of silver, lead, iron, copper, marcasite, vitriol, sulphur, antimony, salt, and coal; none of which are at present wrought, except the iron mine at Stilo, which is farmed at 6806 ducats.

The woods of this country are well stocked with game, which are a great annoyance to the farmers, as they are prohibited from killing them,—the barons having the exclusive right of hunting. Among the most delicate of these are dormice, which are smoked out of their nests in hollow trees, and caught with sharp hooks. They are eaten at the tables of the greatest epicures, and their skin makes very fine leather. Besides sheep, horses, oxen, buffaloes, goats and swine are very abundant in Calabria. The horses are rather small, but handsome, spirited, and patient of fatigue. The breed might be greatly improved; but the prohibition of exportation renders the owners quite indifferent about their perfection. The oxen are white, large, and long horned, except those of the red breed, which have been introduced from Sicily. Buffaloes, goats, sheep, and swine, are in general black.

The inhabitants of this country are a brave and hardy race of men; patient under penury, hardship, and hunger; and possessing symmetry and strength of limb, with an ardent and fiery spirit. His outward appearance—his latticed and miserable garments—his long and black beard—his volubility of gesture—his irrascibility—and his violent declamation, point out the Calabrian mountaineer as the unpolished child of nature. He rises against every haughty demand; but if you speak to him with kindness, he will shew himself complaisant, frank, and benevolent. The common upper dress of almost all classes, from the richest citizen to the lowest muleteer, is a short black vest, suspended from the left shoulder, and a bonnet. The women are in general very plain, and are treated little better than slaves. They are seldom allowed to join in any of their festive amusements; but must remain at home, and take care of their household affairs. When a Calabrian returns from his labour with his wife, he stalks proudly before, with his hands empty, while his wife follows behind heavily laden. Notwithstanding this fierce and unbending demeanour, this people possess great goodness of heart, and a considerable share of intelligence. Though they bear with courage the heavy impositions with which they are loaded, yet they often complain of the burden; and submit, not because the sword is suspended over their head, but that they may discover some means of relieving themselves from the yoke. "The country is filled with scoundrels," said an intelligent Calabrian to Mr Bartels, "because government invites them here. The king, they say, is a man of the best heart and the best dispositions, but great care is taken that he shall never know the true situation of his affairs. He is altogether ignorant of the manner in which we are governed, because those who surround him conceal every thing that may be injurious to their own particular interest. This is the reason why we cry out so much against Naples; and this is the reason why we hate every one that belongs to that country. But we love the king as children love their father, because we hear nothing of him but what is good. We regret only that he never comes among us, as we have so great a desire to know him. Immediately after the earthquake in 1783, an agent was sent from Naples to alleviate the burdens of those who had suffered from this dreadful calamity; but what was the result? Government, it is true, remitted to them all imposts for four years; this, however, was but a vain promise, for at the end of two years they were doubled, by imposing new taxes; and under this yoke we groan until this day." Filled with indignation, the Calabrian finished with these words: *Questo è un governo, che si chiama bugiarone!* "Our government is beneath all censure."

This people are very superstitious. They have charms among them, which are frabricated by certain old women on pieces of parchments, which are supposed to render the wearer invulnerable. These are sometimes sold to the bravos for eighteen ducats, who now, confident of safety, attack their adversaries without fear. They repose also great confidence in judgments, and expect to see every person that jeers at another's defects afflicted in the same way. All kinds of convulsions are here attributed to the influence of malignant spirits; and nearly 1500 women, pretending to be possessed with these spirits, go up annually to Loriana, to be cured by looking at a portrait of St Dominic. Every city swarms with monks, to whom are entrusted the education of the youth of the province, and whose whole learning generally consists in reading their breviary, and saying mass. Many of them are scarcely able for so much, particularly those who have been driven, by the oppression of the barons, to assume the religious habit merely to procure a subsistence. Numerous bands of Zingari or gypsies continually infest this country. This strange tribe have no fixed habitation, but wander wherever profit or convenience dictates. They subsist by the sale of little handicrafts of iron, or by the exchange of horses and asses; but chiefly by pilfering and theft. They are a most abandoned, dissolute, and faithless race of vagabonds. They can be bound by no promise or contract, if the least advantage can be gained by the breach of it; and no cheats are more artful or impudent. They have a peculiar language of their own, which, in sound, seems to bear a great affinity to the oriental tongues; and many of their ceremonies and customs resemble those of the heathens. In 1560, they were banished the kingdom as thieves, cheats, and spies. In 1585, the order was repeated; but not being sufficiently enforced, they remain as numerous as ever.

The population of the two Calabrias, besides the Italian inhabitants, consists of several colonies of Albanese, who differ from the original inhabitants of the country, both in religion, language, and in appearance. Large black eyes, a sallow complexion, short curled hair, and strong and muscular limbs, sufficiently distinguish them from the Italian Calabrese. Their language is peculiar to themselves, and its roots are unconnected with all other European tongues. Though it has been known in Europe upwards of 1000 years, it still remains without an alphabet; and many of its sounds cannot be accurately expressed either by Latin or Greek letters. It abounds, however, with many words borrowed from the old and modern Greek, Latin, Sclavonian, Italian, French, German, and, what is very extraordinary, with many English terms employed in their native signification. The men can speak the Calabrese; but the women, who neither buy nor sell, understand no language but their own, which they pronounce with great sweetness of accent. The Albanese are dispersed over the province, occupying whole villages and towns; but many of their settlements are wretchedly poor and much decayed. "Their habitations," says Father Marafiotti, "are not regular houses, but merely shepherds' huts, or wooden barracks; and they have commonly deep caverns, where they keep their cattle, hogs, and sheep. They are chiefly employed in agriculture, and carry their corn, cheese, and cattle, to the neighbouring towns and villages.

This people were first introduced into Italy about the middle of the 12th century. After the death of Scanderbeg, prince of Epirus, or Albania, the only support of the Christians against the growing power of the Ottomans in Europe, the Albanians abandoned themselves to despair. Unable to withstand the forces of Mahomet I., over whom they had obtained so many glorious victories before they were deprived of their leader, and seeing themselves exposed to the fury of the Turks, they resolved to leave their country, and seek an asylum in the kingdom of Naples. The miseries to which they were reduced before they adopted this resolution, are most accurately described by Pope Paul II., in his letter to Philip Duke of Burgundy. "Albanenses partim cæsi gladio sunt, partim in miserarum servitutem abducti, oppida quæ antea pro nobis Turcorum substinuerunt impetus, in ditionem eorum venerunt. Vicinæ partes, quæ Adriaticum mare attingunt, propinquo motu exterritæ, tremunt. Ubique pavor, ubique luctus, ubique mors et captivitas ante oculos sunt. Audire miserum est, quanta omnium rerum sit conturbatio. Lacrymabile, inspicere navigia fugientium, ad Italos portus appellere, familias quoque egentes pulsas sedibus suis passim sedere per littora, manusque in cœlum tendentes lamentationibus suis cuncta implere." Ferdinand I. king of Naples, being touched with their misfortunes, invited them to settle in his dominions; and, being grateful for the assistance which he had formerly received from their Prince Scanderbeg, who had established him upon the throne, not only assigned them lands, but granted them exemption from taxes, with many other privileges. They fixed their habitations chiefly in Calabria, as being under the protection of the Prince of Bisignano, who had married an Albanese princess; and their numbers continued to increase, by the addition of new colonies, until the reign of Charles V. This prince, to whom they had delivered up the city of Corona in 1532, liberally rewarded its inhabitants who had settled in the province of Calabria, with lands, and an exemption from all imposts, both ordinary and extraordinary, for their fidelity and devotion. Bred to arms, and inured to hardships, the Albanese formed some of the finest troops in the armies of Naples; and, as long as a sound policy directed the affairs of the government, they enjoyed every protection, and were exempted from every impost. But under the viceroys of Spain they were neglected and oppressed. The lands which they possessed were impoverished and exhausted, and could scarcely yield them a scanty subsistence; and the taxes with which they were now loaded reduced them to the lowest state of abjection and misery. A duty of twelve carlini a year was imposed upon every house,—a measure the most partial and unjust, as the poorest Albanese, who had scarcely wherewith to satisfy the cravings of nature, was equally burdened with the richest citizen of the kingdom. From this impost, however, the ancient inhabitants of Corona were exempted; but other circumstances, such as the despotism of the barons, and the persecutions of the Romish clergy, contributed to confound them in the same abject condition. As members of the Greek church, they observed the Greek ritual, and had priests of their own; but a want of colleges, and other seminaries of education for two hundred years, had plunged them into such a state of ignorance and barbarism, that there could scarcely be found a priest among them that knew Greek enough to perform divine service in that language. In this state they would have remained, had it not been for the exertions of M. Rodota, librarian of the Vatican, who being also of the Greek persuasion, prevailed upon Clement XII. to found a college at St Benedetto Ullano, for the education of such young Albanese as wished to dedicate themselves to the service of the church. This establishment was endowed by Charles III. with the wealth of the royal abbey of St Benedetto Ullano, which was also declared to be exempted from every duty whatever. Rodota himself was consecrated archbishop *in partibus*, and acted as president of the college, but in his episcopal powers was subordinate to the Latin prelate of Bisignano, without whose licence he could not confer orders upon his students. Rodota, however, lived too short a time for the good of his settlement. Abuses soon crept in, and its funds have been egregiously mismanaged. Little benefit, indeed, has been derived from it since his death, until the year 1792, when Don Francesco Bugliari, a man distinguished by his talents and his integrity, was called to the head of the seminary. He besought Ferdinand IV. to augment the revenues of the college, and to remove it from St Benedetto Ullano, where the climate was very unhealthy. It was consequently transferred to the convent of St Adrian, and its revenue considerably increased. From that time it has been distinguished in the literary republic by the ability and learning of its professors, and the good conduct of its students. But its prosperity was of short duration. In 1799 it was pillaged by a band of Calabrian banditti; and it was scarcely restored to its former splendour by the exertions of M. Bugliari, than it was again sacked and plundered in 1806. This second disaster overpowered Bishop Bugliari with grief; and "he chose rather," says M. Masci, an Italian writer, "to die by the murderous hands of assassins, than to fly and abandon the place of his most tender regard. His death is felt by every heart. This is the best eulogium that can be paid to his virtues." He is succeeded by M. D. Domenico Belluscio; and the greatest advantages are expected to accrue to Calabria and the hitherto neglected Albanese. The Greek rite is now chiefly confined to the district of Cosenza; the other Albanese who are scattered over the rest of the country, having been either persuaded or compelled to conform to the Roman liturgy and discipline. The Albanese are now a quiet, industrious race. Among them the priesthood is the highest nobility; and, as the clergy are not bound by any vow of celibacy, like their neighbours of the Romish church, their hand is considered as the highest honour to which an Albanese virgin can aspire; and it has been observed, that the most beautiful of the women are generally conferred upon the clergy. In Calabria Ultra, the Albanese possess only six villages, containing 4331 inhabitants, who have all conformed to the Latin ritual; but they are much more numerous in Calabria Citra, where they have thirty villages, containing 30,357 inhabitants, 19,179 of whom still adhere to the Greek church.

This province has in all ages been desolated by earthquakes. It was almost utterly destroyed by these awful visitations in 1638, and in 1659; and in 1783, the whole of Calabria Ultra, from Cape Spartivento to Amantea, above the gulf of St Eufemia, was so completely convulsed, that not one stone was left upon another south of the narrow isthmus of Squillace. The earthquake of 1638 is feelingly described by Kircher, who was an eye witness, in the preface to his *Mundus Subterraneus*; and a particular account of the last most disastrous and calamitous catastrophe, is given by Sir William Hamilton, who was then English minister at the court of Naples, in a letter which is inserted in the "Philosophical Transactions" for 1783. The most violent shocks happened on the 5th and 7th of February and the 28th of March; and it is worthy of observation, that the first week of February had been formerly twice fatal to this country, and the 27th of March was thrice marked with a similar calamity previous to 1783: and, upon comparing the dates of the great earthquakes that have afflicted Calabria since the eleventh century, Mr Swinburne found that seven of them happened in the four first months of the year, one in August, and four in November and December. The miseries to which the Calabrians were reduced upon this unfortunate occasion, cannot be conceived except by those who have witnessed the ruin and desolation which these terrible ministers of destruction have scattered over a populous and fertile country. Above 30,000 inhabitants miserably perished, being either buried in the waves, destroyed by the falling of their houses, or swallowed up by the opening of the earth. The rest, deprived of the necessaries of life, and without habitations, during an inclement season; their fortunes ruined; their friends and families destroyed; and famine, disease, and pain, their only expectation; their condition called for the most speedy and humane assistance. Their Sicilian majesties were wanting neither in exertions nor liberality on this occasion; and to their honour let it be recorded, that all that could be done by a benevolent sovereign, actuated by a true paternal affection for his subjects, was done for the relief and accommodation of the distressed Calabrians. Vessels loaded with every thing necessary were immediately dispatched; and the king ordered an officer to take all the money which the royal treasury could supply or borrow; and even, if required, his own plate, and the very furniture of his palace. All ranks were interested in the miserable fate of this province; and we are informed that the officers and porters belonging to the custom-house of Naples, who were employed in loading the vessels, universally refused to accept of pay for their labour. "Stupendous alterations," says Mr Swinburne, "were occasioned in the face of the country; rivers choked up by the falling in of the hills, were converted into lakes, which, if not speedily drained by some future convulsion, or opened by human labour, will fill the air with pestilential vapours, and destroy the remnants of population. Whole acres of ground, with houses and trees upon them, were broke off from the plains, and washed many furlongs down the deep hollows, which the course of the rivers had worn; there, to the astonishment and terror of beholders, they found a new foundation to fix upon, either in an upright or an inclining position. In short, every species of phenomenon incident to these destructive commotions of the earth, was to be seen in its utmost extent and variety in this ruined country." See Swinburne's *Travels in the two Sicilies;* Bartels *Voyage dans la Calabre, &c.;* Marafiotti *Croniche ed antichita di Calabria; Phil. Trans.* vol. lxxvi. p. 367; and *Annales des Voyages*, vol. i. and iii. *(p)*

CALADENIA, a genus of plants of the class Gynandria, and order Monandria. See Botav, p. 312. and Brown's *Prodromus Plant. Nov. Holl.* &c. p. 317.

CALADIUM, a genus of plants of the class Monœcia, and order Polyandria. See Botany, p. 319.

CALAIS, a sea-port town of France, and the chief place of a district in the department of the Pas de Calais, is situated in marshy ground, which, by means of sluices, may be overflowed at pleasure. It is nearly surrounded by a moat and a wall, which is used as a public promenade. Calais is defended by a citadel on the north-west side, near the sea, and nearly as large as the town. Fort Nieule, which is an oblong square, and was built in 1680, is supported by piles, and is connected with the citadel by a mole. The town has the form of a parallelogram, with the long side towards the sea. The streets are strait, well paved, and tolerably clean, and the houses are well built. The principal public buildings are the arsenal, built by Cardinal Richelieu, several churches and monasteries, a tolerably good theatre, and the hotel at the Lion D'Argent, which resembles a small town in the middle of Calais. The harbour of Calais is formed by a small rivulet; but is now in a great measure obstructed with sand. It commences at the gate of the town, where a large solid quay terminates in two long wooden piers, which stretch into the sea. It is dry at ebb tide, and with a common flow has three fathoms at high water. Nearly opposite to the head of the west pier, there is a bank on which are two fathoms; but between the pier head and the bank is a channel, which has three fathoms at half flood. At spring tides, it is high water at 11 h. 30 min., and the flood sets in N. E. by E. Proposals have repeatedly been made to improve and deepen the harbour of Calais; but these have never been listened to, though the expence would not exceed 1,500,000 livres. At the beginning of the eighteenth century, this harbour admitted frigates of 40 guns. Vessels of 300 and 400 tons entered it at high water, and vessels of 200 and 300 tons at all times; and if it were properly deepened, it would still afford the same accommodation. The shore towards Dunkirk is full of sand banks; and about a mile to the west of Calais, the chalk cliffs appear opposite to those in England, and high sand hills skirt the shores. The country between Calais and Gravelines is well cultivated, and houses, embosomed in woods, rich meadows, and cornfields, every where appear.

The principal manufactures of Calais are stockings and soap, and it possesses a very considerable coasting trade. Calais is the great mart for the salt and gin of Holland; and the fishing of cod, herrings, and mackerel, is carried on to a very considerable extent. Two fairs are held annually here; one on the 10th January, which continues for ten days, and another on the 11th July, which continues nine days; and the principal articles of traffic are cattle, jewellery goods, and iron and copper ware. The trade of this place is much facilitated by the canals which communicate with Gravelines, Andres, St Omer, Dunkirk, and several other places in the north of France. In the time of peace, regular packet boats sail twice a week with the mail between Calais and Dover. Near Calais is a pillar, erected on the spot where the balloon of Blanchard descended. Population, 7600. Long. 1° 51′ 1″ East, Lat. 50° 57′ 31″ North. See Trotter's *Memoirs of Mr Fox*, p. 41, 48. (π)

CALAMINES. See Philippine *Islands.*

CALAMO, Calmino, or Calimena, the *Claros* and *Calydna* of the ancients, is an island of the Archipelago, not far from Mitylene, and about five or six leagues in circumference. "There are on this island," says Sonnini, "some very lofty mountains, a population far from numerous, and the remains of an ancient town on the west coast; on the other side, a village, which also bears the name of Calamo, built on the summit of a mountain; and near to it, a tolerably good harbour, formed by a bight or small gulf, before which lies an islet, that shelters it from the winds and sea: but this harbour is little frequented; the main land, which is in the vicinity, and the larger islands, which are within reach, present harbours still better, and at the same time more calculated for the supply of provisions to navigators, and for the speculations of tenders. Calamo is, in fact, a poor island, which cannot provide for the subsistence of its inhabitants, almost all occupied in procuring foreign resources by a carrying trade. Their mountains, indeed, contain minerals; but this circumstance, which, under another government than that of the Turks, would constitute the wealth of a country, would under them become a source of oppression and ruin." Sonnini's *Travels in Greece and Turkey*, chap. xiii. p. 160, 161. (*w*)

CALAMUS, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 185.

CALAMY, EDMUND, an eminent non-conformist divine, was born in the year 1671. He was son of Mr Edmund Calamy, minister of Moreton, in Essex, and grandson of Mr Edmund Calamy, minister of Saint Mary Aldermanbury. The father's life was distinguished by nothing more remarkable than his suffering, like many others, by the infamous act of uniformity. But the grandfather had a character which raised him above most of his contemporaries, and rendered him worthy of some notice. After going through a course of liberal education, he entered the church, and continued a conformist, though not a very strict one, till the imposition of Bishop Wren's articles, and the reading of the book of sports, wounded his conscience, and obliged him to withdraw his attachment. He was one of the authors of the famous book against Episcopacy, known by the name of *Smectymnuus:* he was nominated by the House of Lords, in 1641, as one of the sub-committee for religion: he acted a conspicuous part in the Assembly of Divines; his influence in the city of London, on account of his ministerial talents, was greater almost than that of any other man: he strenuously and boldly opposed the regicides of Charles I., and was active in promoting the restoration of the second Charles, who rewarded him, by first offering him a bishopric, of which he could not conscientiously accept, and then subjecting him to all the rigours that were inflicted by the act of uniformity. He is said to have died of a broken heart, occasioned by his seeing London in ashes, after the great fire in 1666.

The subject of the present article, who, in many points, resembled his grandfather, received his early education chiefly from Mr Samuel Cradock, who kept a private academy at Wickhambrook, in Suffolk, and under whose able tuition he remained for a considerable number of years. In that and the other schools which he previously attended, he not only studied with so much diligence and success, as to secure the high approbation of his masters, but also displayed such amiable dispositions, as to lay a foundation for lasting friendship, with men whose friendship was equally useful and honourable to him in future life. Among these may be mentioned, Mr Dawes, Mr Hugh Boulter, and Mr Timothy Godwin, who were afterwards archbishops respectively of York, Armagh, and Cashel, and whose esteem for Mr Calamy was neither destroyed by the contrariety of their religious opinions, nor diminished by the difference of their ecclesiastical rank.

At the age of seventeen he went to the university of Utrecht, where he engaged in study with redoubled ardour, and made distinguished proficiency in the several branches of learning to which he applied himself. He was much noticed by the professors. He acquired an intimacy, which was never broken off, with Lord Spencer, afterwards Earl of Sunderland, and secretary of state to Queen Anne; and with Mr Charles Trimnell, who rose successively to the bishoprics of Norwich and Winchester. And so great was his reputation, that he had an offer of a professor's chair in the college of Edinburgh from Principal Carstairs, who had been sent over to Holland to procure a person properly qualified for such a place. This offer he declined, and soon after he returned to England. He went first to Oxford, where he laboured to improve himself, by researches in the Bodleian library, conversation with literary men, and other means and opportunities of making intellectual attainments, which were to be found in that seat of learning. Having determined to betake himself to divinity, he directed his attention closely and steadily to the various subjects comprehended under that science. He carefully searched the Scriptures; he perused the writings of the primitive fathers: He made himself well acquainted with ecclesiastical history; and then, entering on the later controversies, considered with particular care and interest the one which subsisted between the Church of England and the nonconformists. His examination of its merits was long, minute, and temperate; and it terminated in a decided attachment to that party, which, the claims of both being supposed equal, a worldly mind would certainly not have preferred. United with the dissenters from convictions of right and duty, he soon employed his talents as a preacher of the gospel in that communion; and, after labouring for some years in this subordinate character, he received Presbyterian ordination in 1694. This ordination was the first public transaction of that nature which had taken place since the passing of the act of uniformity. It was usual, on former occasions, to have no person present except the ordainer and the ordained; but Mr Calamy was resolved to have as great a degree of publicity as possible connected with his admission into the Christian ministry. And, after encountering some difficulties from the timidity of his brethren, he succeeded in procuring the ordination of other six at the same time. The whole service, which was conducted with requisite solemnity, as well as unprecedented openness, lasted from ten in the morning till past six in the evening. Mr Calamy, after holding some inferior situations, was, in 1703, chosen pastor of a large congregation in Westminster, London. Previous to this appointment, he had made himself useful to the dissenting cause, and acceptable to all its supporters, by publishing an *Abridgment of Mr Baxter's History of his Life and Times;* to which he added, an account of other ejected ministers,—an apology for themselves and their adherents,—and a continuation of their history to the year 1691. Of this work he published, in 1713, a second edition, with considerable improvements, in 2 vols. 8vo. and dedicated it to the duke of Devonshire. It, of course, gave great offence to churchmen, and high satisfaction to dissenters, when it first appeared; and to this day is regarded with similar emotions by their respective descendants. Bishop Burnet thanked him for it, declaring, that he had read it with much pleasure. Some attacks were made upon it; in repelling which, Mr Calamy evinced both strength of argument and moderation of temper. His conduct to Mr Hoadley, the celebrated bishop of Bangor, was particularly candid and enlightened, and deserves to be recorded as a singular fact in the history of religious controversy. Mr Hoadley had written an answer to the tenth chapter of Mr Calamy's *Abridgment*, respecting the reasonableness of conformity to the church of England. This gave rise to various pamphlets, in which these champions contended against each other with great talent and great perseverance. At length Mr Hoadley published a defence of Episcopal ordination. To this Mr Calamy composed an argumentative and historical reply; but, with a forbearance and a generosity which do his memory the highest honour, he did not print it, because it would have diverted his antagonist from that struggle in behalf of political and religious freedom, which he so ably maintained against the abettors of the corporation and test acts. Such an exhibition of liberal principle, is of itself sufficient to make the name of Calamy dear to every friend of liberty, and every admirer of moral greatness.

One of the pamphlets which he produced in the course of this dispute is worthy of being particularly noticed, on account of the unqualified praise bestowed upon it by Mr Locke. It is his *Defence of Moderate Nonconformity*, the introduction to which that eminent philosopher affirmed, in a message to the author, to be invulnerable both in its principles and its reasonings. In 1709, Mr Calamy went into Scotland. He there met with the kindest reception, and most respectful treatment. The universities of Edinburgh, Glasgow, and Aberdeen, conferred on him the degree of doctor in divinity. Every attention was paid to him by the professors and literati of the places which he visited; and his impressions of the Scotch nation were, upon the whole, highly favourable and pleasing. It was about this time that the French prophets made so much noise in England. The principles and conduct of these suspicious enthusiasts were thought deserving of the interference of government, and the attorney general was ordered to prosecute their ring-leaders. Before, however, any decisive measures were adopted, Lord Godolphin and Mr Harley consulted Dr Calamy, who, from his knowledge of their pretensions and character, and his general sagacity in such matters, was well qualified to give a sound advice. He advised government to abstain from giving any disturbance to the self-created prophets. His counsel was prudently adopted; and the consequence was, that the fanatics, who had excited so much unnecessary alarm, soon dwindled away into insignificance and contempt. Dr Calamy assisted in the extinction of this miserable sect also, by writing a *Caveat against the New Prophets*, for which he received the thanks of Queen Anne, who considered it as a public service.

In the years 1718, &c. there were keen disputes among the dissenters respecting subscription to the first article of the church of England, which relates to the doctrine of the Trinity. He attended one of their private meetings; but distinctly foreseeing the quarrel which ensued, and afraid of the evil consequences to which it might lead, he attended no more; and neither openly joined with the one party nor with the other, when they even came to a division on the subject of discussion. He was not indifferent, however, to the doctrine of the Trinity, which he defended in thirteen sermons preached at the Merchants Lecture in Salter's Hall. These sermons he published in 1722; and for this volume, the author not only received the thanks of several dignitaries of the established church, but was also honoured with gracious acknowledgments, and a gratuity of fifty pounds, from the king himself. In 1727, he finished his great work, entitled, *A Continuation of the Account of the Ministers, &c. ejected after the Restoration.* This book is well known to those who are conversant in the history of that period. It reflects the highest credit on the industry and impartiality of the author, though it has not been so fortunate as to escape the censures of high-church writers; and is most deservedly popular, both as a collection of biographical sketches, and as a repository of interesting and important facts. Dr Calamy, with a high reputation for learning, judgment, candour, benevolence, and piety, died (1732,) in the sixtieth year of his age, having been twice married, and leaving behind him several children. See Mayo's *Funeral Sermon upon Edmund Calamy, D. D.;* Calamy's *Abridgment of the Life of Baxter; and Biographia Britannica.* (τ)

CALANCHOE. See Verea, Botany *Index.*

CALATAGIRONE, the name of a city in Sicily, situated in the Val di Noto, on the top of a high insulated hill, and surrounded with groves of cypress. The road up the hill, which is well paved, is so extremely steep, that it can scarcely be ascended by any other animal but a mule or an ass. This city is considered as very ancient by the natives, who suppose it to have been the inland Gela or Gelone of the ancients. Ancient coins are still found here, and De Non is of opinion, that it must have been the *Hybla-hærea* of antiquity. The inhabitants of Calatagirone are reckoned the most polite people in the island. Many of them live in an elegant manner, but the greater proportion are employed in agriculture, and in the manufacture of potters ware. The town was fortified by the Saracens, from whom it was taken by the Genoese. The corporation is one of the richest in Sicily, from the estates with which the bravery of the inhabitants was rewarded by Earl Roger. See Swinburne's *Travels in the Two Sicilies*, vol. iv.; and De Non's *Travels in Africa*, p. 292. (π)

CALBARY, Calbari, or Calabar, is a district lying on the west coast of Africa, between the Rio Real, and the river Forcades. The river Calbary, which waters the district, and from which it takes its name, though large, is very shallow, and is only navigable by small vessels. The principal place of the country, which is likewise called Calbary, is situated on the north bank of the western arm of the river, and is the place with which the Dutch had formerly established a very considerable trade, which is now transferred to Bani. The other towns are Wyndorp, or Fokhe, situated near the coast, on the west bank of the river; Belli, situated about twelve leagues west of the town of Calbary; and Culeba, the capital of the province of Bani.

The face of the country is almost entirely covered with thick woods, and is inhabited more by wild beasts than by the human species. Though the rains are very frequent, yet the earth is so sandy, that no mark of humidity remains after the rain has ceased. According to Grazilhiers, who wrote in 1699, about 30 or 40 tons of ivory were annually exported by the Dutch, who also carried on a very extensive traffic in slaves, which they received in exchange principally for bars of iron, copper, and brass.

The cannibal Negroes, who inhabit the eastern banks of the Calbary, circumcise all the marriageable women; they sell their captives, and eat only those who are slain. The canoes which they use are sixty feet long and six broad. The rowers are seated on cross benches; and near each of them hangs a quiver of arrows. Reed mats spread upon poles, and fixed like tents, protect the masters during the night, while the slaves are exposed to all the rigour of the weather. A full account of the trade in slaves, which was formerly carried on in Calbary, will be found in Peuchet's *Dictionnaire de la Georgr. Commerçante*, vol. iii. p. 250. (*w*)

CALBONGOS, or CALBONGAS, the inhabitants of a country on the coast of Guinea, in Africa, lying between the river Rio del Rey and the river Gabon, but principally upon the banks of the former. The country is low and marshy, and the village where the commerce is carried on is situated on the east point of the embouchure of a small river, which discharges itself into the Rio del Rey, and which is navigable for chaloupes. The trade was altogether in the hands of the Dutch, who exported annually from the country about 400 or 500 slaves, and from 1000 to 1200 tons of ivory, which they received in exchange for bars of iron, necklaces, bracelets, &c. As the Calbongos are little known, it is customary to stop at the Prince's Island and the island of St Thomas to take Portuguese guides. The greatest inconvenience in the country of the Calbongos is, that there is no fresh water but what is collected on the tops of the houses during wet weather, and the air is constantly loaded with fogs.

A people called the Ambozes belong to the country of the Calbongos. They have several villages to the east of Cape Camarones, which Barbot calls Serges, Bodi, and Bodiva. The land produces all kinds of plants and fruits known in Guinea, except palm trees. In this place vessels may be furnished with cattle, poultry, fruit, and other refreshments. No palm wine is to be obtained; but in place of this the inhabitants use a very agreeable beverage, which is made of roots called Guiandas, boiled in water.

Upon the coast there are three islands called the Ambozes Isles, about seven leagues from the river Camarones, and six leagues from Cape Ambosine, towards the south east. The most eastern of these is the greatest and the most populous. Vessels may pass between the three islands, and sometimes cast anchor below the greatest, to traffic in elephant's teeth and slaves. Though these islands appear rocky at a distance, yet they are fruitful and populous. Palm trees are found here in abundance, though there are none on the opposite continent. Wine of palm is made in great quantities, and the sea produces much fish. The inhabitants understand the Portuguese language, and are reckoned the most dangerous negroes in Guinea.

The Calbongos are represented as filthy, wicked, and deceitful. They are insincere in their dealings, and destitute of natural affection. Parents will sell their children, husbands their wives, and brothers their sisters. They go almost naked, and bedaub their bodies with various colours. All criminals are said to be declared innocent, who make an incision in their arms and suck out the blood. (*w*)

CALCEOLARIA, a genus of plants of the class Diandria, and order Monogynia. See BOTANY, p. 83.

CALCUTTA, the capital of Bengal, and of all the British possessions in India, is situated on the eastern bank of the Hoogly, which is navigable up to the city for the largest Indiamen. It extends fully three miles along the river, and is comparatively a modern built town, having risen, during the last century, from an insignificant village called Govindpour, to its present state of grandeur. The houses of the English, which constitute a particular quarter of the city, are constructed entirely of brick, plastered over with *Chunam*, a species of mortar made from shells, which, when kept clean, rivals the finest marble. They are, in general, detached from each other, to give a freer circulation to the air in this hot climate, and have a very elegant appearance. Those of Charinga road in particular, resemble more the palaces of monarchs than the houses of private gentlemen and merchants. Their construction is also well adapted to the climate. The apartments are spacious and lofty, with large verandahs, where the family often sit and dine during the hot season. The approach is generally by a flight of steps, with great projecting porticos, or surrounded by colonnades or arcades, which give them the appearance of Grecian temples. Very little furniture is used, as any thing that obstructs the circulation of the air is a great inconvenience; and there is scarcely a ceiling in all Calcutta. The Black town, however, which is inhabited by the natives, presents a striking contrast to the beauty of the other. It is like most towns in India, which, according to Mr Rennel, are "all built upon one plan, with exceeding narrow, confined, and crooked streets, with an incredible number of reservoirs and ponds, and a great many gardens interspersed. A few of the streets are paved with brick. The houses are variously built: some of brick, others with mud, and a still greater proportion with bamboos and mats; and these different kinds of fabrics, standing intermixed with each other, form a motley appearance. Those of the latter kind are invariably of one story, and covered with thatch. Those of brick seldom exceed two floors, and have flat terraced roofs. The former classes far outnumber the last, which are often so thinly scattered, that fires, which often happen, do not sometimes meet with the obstruction of a brick house through a whole street." The citadel of Fort William, which stands about a quarter of a mile from the city, upon the same side of the river, is a magnificent work, but much too extensive for defence. It is built in the form of a pentagon, with several outworks, and is laid out in squares and regular buildings, interspersed with groves of trees, which afford a comfortable shelter from the noontide heat. It contains bomb-proof barracks for 10,000 men, and would require 600 pieces of cannon to mount all the works, which, however, are guarded by mines and countermines. The whole is surrounded with a ditch, into which water can be introduced from the river, by means of flood-gates, to the height of 8 feet. This fortress was commenced by Lord Clive in 1757, immediately after the victory of Plassey, and was intended as a tenable post in case of extremity; and to prevent a repetition of such insults and cruelties towards the British, as were experienced by Mr Holwell and his unfortunate companions, upon the taking of Calcutta in 1756 by the Soubah of Bengal. It commands a most extensive prospect on every side; and all ships that pass up or down the Hoogly are exposed to its fire.

Between Fort William and the city is a level plain called the esplanade, where the inhabitants of all ranks and descriptions daily resort for air and exercise. From day-break, until the sun has got to some height above the horizon, it is crowded with Europeans and natives, who come to enjoy the cool air of the morning; and, in the evenings, it presents a grand display of equipage and beauty, with every variety of vehicle and complexion; from the coach and four to the one horse chaise, with the palankeens and hackeries of the natives; and the dark Hindoo and tawny Moor contrasting with the fair and florid countenances of the English. On the west side of the esplanade stands the new government house, erected by the Marquis of Wellesley. It is a noble and beautiful structure, worthy to be the residence of the head of a great empire. Over the four colossal arches or gates that lead to it, are placed sphinxes, with various figures and emblems; and over the eastern and western gates are emblazoned the king's and company's arms. "With respect to the interior of the building," says a modern author, "any adequate idea of it cannot be conveyed by words: the eye, not the ear, must be the medium of communication. The marble hall, in particular, brought to my mind many of the glowing descriptions in the Arabian Tales, of enchanted castles, &c. and indeed I could scarcely persuade myself, that I was not treading on magic ground, all the time I was wandering through it." The old fort, which is situated near the centre of the town, has been converted into a custom-house; and the "black hole" is now part of a go-down, or warehouse. In front of the gate, is a handsome stone obelisk about 50 feet high, which was erected by Mr Holwell to the memory of his fellow prisoners, with whose names it is inscribed. It records also the infamy of those, who, by removing their ships from the vicinity of the fort, left so many brave men at the mercy of a tyrant. The other public buildings of Calcutta are the court house, over which are two handsome assembly rooms; the Armenian church, and one English church! In the middle of the city is a large reservoir, or tank, dug by order of government, in order to supply the inhabitants with water during the dry season, as the water of the Hoogly is then rendered brackish by the influx of the tide. It covers upwards of 25 acres of ground; and the number of springs which it contains preserves the water always sweet and fresh, and nearly at the same level. A rail is placed round it; and though no person is allowed to wash in it, yet all are at liberty to take as much water as they please.

Calcutta is the residence of the governor-general of India, and the seat of the supreme court of judicature, which consists of four judges, who dispense justice according to the laws of England. The jurisdiction of this court embraces all the company's territories in this part of India, and also extends to every case, civil or criminal, that may occur upon the sea between the Coromandel and Malacca coasts. It does not, however, reach to the higher stations; but in these the European settlers have come under an engagement to be amenable to its authority. The upright proceedings, and the decorum with which the business of the court is conducted, have gained it the confidence of the inhabitants; and though many of the company's servants, whose avarice or dissipation have led them to injustice, bear it a secret and rooted dislike, it has contributed greatly to the comfort and protection of the natives, and has in a manner raised them to an equality with Europeans. That discretionary power, which the English formerly claimed over the Hindoos, and which, they contended, was absolutely necessary, in order to maintain subordination and obedience, is now completely abrogated. The Hindoo can appear in court without any fear of insult or violence, and rigidly demand the payment of his wages or accounts. If the debtor is unable to comply with his just demand, he feels gratified rather than hurt, that he can command the personal liberty of an European. The plea of colour, of country, or of religion, can avail nothing in the eyes of an upright judge: impartial justice is administered equally to all. Petty delinquencies are tried by a superintendant of police, and several inferior justices of the peace, who are Europeans; and the peace of the city is maintained by a few companies of sepoys, who regularly patrole the streets.

Calcutta is the emporium of Bengal, and the channel through which the riches of the inland provinces pass to Europe. Ships belonging to every nation are seen in its harbour, and every mercantile speculation is carried on here with a zeal and activity equal to that of any other city in the world. Its foreign trade extends to every port of any note in Asia and Europe; and the annual dealings of some houses has been estimated at two crores of rupees, about 2,400,000*l.* sterling. Its commerce in sugar, opium, silks, muslins, &c. is very considerable. Vast quantities of salt are exported to Asam, for which it receives gold, silver, ivory, musk, and a particular species of silky cotton. Cowry shells, which are used in the country as a small coin, are brought from the Maldives in exchange for rice; and fine muslins and calicoes form a principal article of exportation to Europe. The advantageous traffic, however, which formerly subsisted between this port, and Pegu, Siam, and the Malay islands, and which consisted in the exchange of silver bullion, gold dust, and precious stones, for raw and wrought silks, coarse cotton cloths, opium, and saltpetre, is now very considerably diminished, and, according to Mr Forster, unless some favourable change is speedily effected, bears the appearance of a total failure. "The extent of the private trade of Calcutta," says Dr Tennant, "cannot be estimated justly, either from the numbers or the burden of the ships belonging to that port. Till lately, there were only 60 that properly belonged to the British merchants here, and their burden was about 27,000 tons. But it is well known, that their concern in foreign ships is very considerable." For a full account of the trade of Calcutta, we must refer our readers to the article INDIA.

Great difficulty and expence was formerly experienced at this port, in unshipping merchandize, from the want of a proper landing place. This of late has, in some degree, been obviated by the erection of a quay in front of the custom-house; and it has been proposed to carry the embankment the whole length of the town, which will undoubtedly be a great improvement. The dangerous navigation of the Hoogly, however, is still a considerable drawback to the trade of Calcutta. The banks which infest the mouth of the river, and are formed by the sand and mud washed down during the rains, are continually changing their situation and dimensions; and it requires great attention, and almost constant sounding, to place the buoys in proper positions, so that vessels may not be misled when entering the river. This duty belongs to the pilot service, which is under the direction of the marine board, and is, in general, performed with great care. At the confluence of the Hoogly and Old Ganges, there is a very dangerous shoal called the James and Mary, on which vessels are frequently lost, particularly in light winds, when the stream is running strong on the flood into the latter river. Ships, when attempting to turn into the Hoogly in such circumstances, are often carried upon the shoal, when they are upset in an instant, and are rolled over and over in a most frightful manner.

The British merchants, who are not in the service of the company, constitute a numerous and respectable class of the community; and though many of those who belong to the civil and military departments of the government effect a superiority over them, which they are entitled to, neither by their talents, opulence, nor character. Several of these merchants have acquired large fortunes, and display an elegance and splendour in their mode of living, to which few of that order in society ever aspire. Among the foreign merchants, the Armenians approach nearest to the English in number and respectability, and also in their fondness for show and elegance. They are a peaceable and inoffensive people, regular and diligent in business, and much attached to the British government. Many of them are possessed of large capitals, and carry on an extensive trade to China, and to the ports towards the west as far as the Persian Gulf. The Moguls, however, are the most wealthy: and from the exorbitant rate of interest at which they let out their money, some of them draw an annual revenue amounting to three times more than is yielded by any capital in Britain. But however rich, the Hindoos still retain their narrow ideas, and parsimonious habits. Their houses and shops are mean and disagreeable; and the only seasons when they launch out into any extraordinary expence are at marriages, and religious festivals. At these ceremonies the company, composed of all ranks and denominations, assemble under a large canopy illuminated with splendid lustres. Otto, rose-water, and other perfumes, are scattered with great profusion, and the sweetmeats are served in vessels of gold. These, with the monotonous drawls of singing girls, and sometimes a pantomimical performance, constitute the whole entertainment.

The retail trade of Calcutta is chiefly in the hands of the Banians, Sarkars, and Writers, who go about hawking their commodities, and searching after cheap purchases; and such is their eagerness for money, that every species of low cunning and deceit is employed to over-reach the purchaser. So far, however, is imposition in this way considered as any discredit among their countrymen, that those who are noted for it, obtain the appellation of *pucka adme*, men of strong parts. Yet these people often sell their goods at a lower rate than they can be purchased from Europeans. This they are easily enabled to do, as their wares are generally bought at sales, where they are often procured, on very moderate terms; and also from the low rents of their shops, which being situated in the common bazars, must be infinitely cheaper than the splendid apartments of the British merchants. Indeed, the charges of rents, clerks, freight, insurance, with the innumerable items of godown, deeply effect the profits arising from mercantile concerns in this city. Not many years ago, a house barely sufficient to accommodate a genteel family, could not be procured under six or eight hundred pounds a year. This, together with the wages of a numerous train of servants, which the superstition of the natives, by deterring them from performing service beyond one specific kind of work, has rendered absolutely necessary, greatly swells the annual expenditure of a family. The exorbitant rents, however, have of late been reduced, in some measure, by the speculation of house-building, which has been carried to an immense extent; but this reduction can never be very great, for, considering the rate of interest in this country, a considerable annual income is lost in the capital sunk in building.

But notwithstanding the heavy expenses to which the British merchants and other inhabitants of this city are exposed, their acts of munificence and charity to indigent persons equal, if not surpass, those of any other body of men whatever. Numerous useful and benevolent institutions have also been established, and are supported entirely by their liberality. Among these are, an hospital for the reception of such natives as, from accident or disease, may stand in need of medical aid; two schools for the relief of the orphans both of the privates and officers in the military service of the Company, at which, from six to seven hundred children are educated and maintained; a free school, which educates 400 children, besides others of inferior note.

The college of Fort William, which was established by the Marquis Wellesley, has been partly abolished by the court of directors. This seminary was intended by its noble founder, not merely for the education of the junior servants of the company, but also to watch over their conduct, and to preserve them from the many dangers and temptations to which young men are exposed on their arrival in India. What is retained, regards chiefly their instruction in the native languages. It assumes no controul over their actions or their expenditure. In these respects they are left entirely at their own disposal; and we need not wonder that, from their little experience in life, the scenes of extravagance and dissipation in which they are led to mingle, and the facility of receiving money in this country, many are involved, at an early period, in difficulties and embarrassments from which some of them, by many succeeding years of economy, are scarcely able to extricate themselves. Were it indeed possible, by such an institution as was at first proposed, to preserve these young men from the contamination of bad example, and from those vices and follies in which at such an age, they are too apt to indulge, we must regret that the directors should have been prevented, either from a principle of economy or of jealousy, (with which they have been charged,) from carrying the original plan into full execution. "Had Lord Wellesley's plan of a college," says Lord Valentia, "been acceded to, this desirable end would have been attained; and the young men, subject to the restrictions and discipline of such an institution, would no longer have met with those facilities in raising money, with which their present situation so often presents them. They must, in consequence, have been obliged to confine their expenditure to the liberal allowance of the East India company, till called to the higher appointments, when, unincumbered in their affairs, and uncorrupted in their minds, they might rapidly and honestly have acquired, at an early period of their lives, that opulence, which would ensure them affluence and comfort in their native country." But Dr Tennant seems to hold very different opinions from those of his lordship respecting the utility of this college. When speaking of it in his *Indian Recreations*, he says, "As it is for business and not education that these gentlemen are sent to India, it is difficult to foresee any benefit that will ever result from this measure. Instruction in the native dialects is, in general, all that is necessary to qualify them for the exercise of their duty, and this they have hitherto received from Moonshees, at the spare hours that are not employed in their different vocations. The practice of their professional duty of itself, greatly assisted them in acquiring the language of the natives; while it prevented the loss of several years, and a great expence, which is incurred at this dissolute seminary." The directors, however, seem to have been convinced of the expediency of some other establishment, at which their junior servants might be qualified for their particular appointments; and consequently a college has been lately established at Hertford in England, upon a plan somewhat similar to that of the original insitution. But however well qualified the young men may be in respect to education, and a knowledge of their profession, when they leave England, they are still liable, upon their arrival in India, to be infected with the vices and extravagance of a dissolute capital. The most effectual remedy, we presume, for the evil complained of, would be, an immediate appointment to some situation; instead of allowing them to linger in Calcutta, without employment and without a guide, exposed to the contamination of profligacy and folly.

The Asiatic society, which was instituted by Sir W. Jones, in 1784, for the purpose of enquiring into the history, antiquities, arts, sciences, and literature of Asia, offers to rival the Academy of Inscriptions at Paris, and its researches contain much valuable and useful information upon subjects with which Europeans were formerly very little acquainted.

Situated in the midst of a flat and marshy country, and exposed to the tropical heats, Calcutta can never enjoy a salubrious atmosphere. At its first establishment as an European colony, the climate was almost equally destructive with that of Batavia; and though now greatly ameliorated, by clearing away part of the trees and jungle in the vicinity, by draining some of the most offensive marshes, and by filling up many of the tanks in in the streets, it still proves a severe trial to European constitutions. Many fall a sacrifice to its first attacks, and more receive the seeds of a slow but certain destruction. "A sallow and livid complexion," says Dr Tennant, "is so universal, that when you behold a face of the roseate hue, you can pronounce that its owner is newly arrived, nearly with as much certainty as if you heard that part of his history from his own mouth." Of the numerous female adventurers who resort to this settlement, with the hope of a speedy matrimonial connection, few retain beyond a season the bloom of health. Consumptions are very common among them; and many, after remaining for years in a single state, are forced to abandon the forlorn hope, and return to Europe with an impaired constitution and the loss of beauty, often their only recommendation. Diseases, however, are not so prevalent in this city as formerly, which is owing more to the greater temperance in the use of spirituous liquors, and the superior construction of the houses, than to any material improvement in the atmosphere. The inhabitants are now also better acquainted with the means of counteracting the effects of a bad climate; and from the increased knowledge of medicine, the nature and treatment of the peculiar disorders of the country, have been more precisely ascertained. But notwithstanding these improvements, much still remains to be done with respect to their manner of living. No fashionable parties sit down to dinner before seven or eight at night, which, in this hot climate cannot fail to be prejudicial to the health, particularly when we consider that, even independent of a loaded stomach, it is at all times difficult to procure any thing like a refreshing sleep. In the numerous and gay society of this capital, too many opportunities occur of exceeding the bounds of strict sobriety; and though few people indulge less in this respect than the inhabitants of Calcutta, yet the frequency of the application, often proves a most destructive enemy to the constitution. In no country ought the advice of the poet to be more strictly adhered to:

——"Beyond the sense
Of light refection, at the genial board,
Indulge not often; nor protract the feast
To dull satiety.——
——"For know, whate'er
Beyond its natural fervour hurries on
The sanguine tide; whether the pregnant bowl,
High season'd fare, or exercise to toil
Protracted; spurs to its last stage—tird'd life."
ART OF PRESERVING HEALTH.

Calcutta was first erected into an European settlement in 1690, when Mr Job Charnock, the Company's agent in Bengal, obtained leave from the Mogul to remove the English factory from Hoogly; and he fixed upon this spot as the most proper for its new situation, without any regard either to the convenience of its approach, or the salubrity of the climate, but merely, it is said, on account of a large shady grove which stands in the vicinity. Notwithstanding its disadvantages, however, it gradually increased both in population and opulence; and about the middle of the following century, fifty or sixty European vessels were annually loaded with rich cargoes at its port, besides other small craft trading to the adjacent countries. The colony had hitherto enjoyed the countenance and protection of the native powers, but on the death of the old Soubah, or viceroy of Bengal, in 1756, his adopted son, Suraja Dowlah, by whom he was succeeded, formed the design of driving the English from the country. Led on by the hope of a rich plunder, which he supposed to be concealed in the fort of Calcutta, he commenced hostilities upon the most frivolous pretences, and invested the English factory of Cossimbazar. Fraud and force were both employed for its reduction, which was soon accomplished, and the Soubah then marched to Calcutta with an army of 70,000 horse and foot, and 400 elephants. He was repulsed in repeated attacks upon the redoubts with great slaughter; but the governor, Mr Drake, intimidated by the superiority of his force, withdrew his troops from the outposts, and abandoning the city to the enemy, retired within the fort. In a council of war, it was declared, that their ammunition was almost expended, and that what remained was scarcely sufficient for three days. In consequence of this information, Mr Drake, who declared himself a Quaker, with some principal persons residing in the settlement, and part of the garrison, took refuge on board the ships in the river. The command of the fort then devolved upon Mr Holwell, who, with a few brave officers and a feeble garrison, consisting only of 250 effective men, maintained it with uncommon bravery and resolution, against all the force of the Soubah. Their ammunition, however, being at last almost exhausted, and many of their numbers having fallen in the unequal conflict, Mr Holwell hung out a flag of truce; and intended to avail himself of the opportunity to escape to the ships, but they had fallen several miles down from the fort, without leaving a single boat to facilitate the escape of its brave defenders. In this emergency also, before an answer could be received from the Soubah, the Dutch guard had betrayed their post, and had delivered up the back gate to the enemy, who rushing in, soon overpowered the garrison by their superior numbers. At an interview which Mr Holwell had with the Soubah, that prince promised, on the word of a soldier, that no injury should be done to any of the prisoners. But, notwithstanding this solemn assurance, they were all driven, to the number of 146 persons, of both sexes, into a dungeon called the black hole, a cubical space of about 18 feet; where, fatigued with hard duty, and many of them wounded, they were left to the torments of thirst and suffocation. Humanity shudders at the very idea of their miserable situation,—cooped up in a narrow cell, in a close sultry night, under such a climate as that of Bengal, without the least current of refreshing air. Two windows towards the west, which were strongly barred with iron, were the only openings at which the air could be admitted, and here there was no perceptible circulation. Enraged at finding themselves thus cruelly betrayed, they endeavoured to break open the door, determined rather to rush upon the swords of the barbarians, than remain exposed to an excruciating death; but the door being made to open inwards, all their efforts were unavailing: Mr Holwell, who stood at one of the windows, accosted a jemmautdaar, or serjeant of the Indian guard; and promised him a thousand rupees, if he would remove one half of them into a separate apartment. The soldier, allured by the offer of such a reward, immediately retired for the purpose of obtaining permission from the Soubah, but the tyrant was asleep, and no person dared to disturb his repose. Despair and distraction now seized upon these miserable sufferers. A profuse perspiration overspread every individual, and this was attended with a raging thirst, which increased in proportion as the body was drained of its moisture. In vain they stripped themselves of their clothes; in vain they sat down upon the ground, and put every hat in motion to produce a refreshing undulation. Many of them falling down, were instantly suffocated or trodden to death. A difficulty of respiration succeeded, and every surviving victim gasped for breath. New efforts were made to break open the door, but in vain. Execrations and abuse was then poured upon the guard, with the hope of provoking them to fire into the prison. Their sufferings now became intolerable; and the cry of "water! water!" issued from every mouth. The jemmautdaar was even touched with pity at their distress, and ordered some skins of water to be brought; but, the only way of conveying it being through the bars of the window, in hats, and every one struggling for a share, the greatest part of it was lost. While those who stood near the windows catched a little, none reached their companions at the other end of the prison, who besought them, in the most moving strains, to send them some relief. The water, however, instead of allaying the thirst of those that received it, only heightened their delirium, and enraged their impatience for more. A horrid scene of confusion ensued. Such as were at a distance, rushed towards the window, crying out for water. In the contest, many were pressed down and trampled to death. The barbarians without laughed at their miseries, and as they supplied them with water, held up lights to the bars that they might enjoy the inhuman pleasure of seeing their hapless victims contending for the baneful indulgence. It was about eight o'clock when they were first entombed in this infernal place; and before eleven, one third of them had perished. Mr Holwell, who found himself so closely wedged up by the pressure towards the window, as to be incapable of motion, begged, as the last token of their regard, that he might be allowed to retire from the crowd and die in peace. Even here respect was shewn to his rank and character. The pressure was removed, and he retired to the farther end of the prison, where, seeing many of his particular friends lying dead, he laid himself down among them, and recommended his soul to heaven. His thirst, however, grew insupportable, his difficulty of breathing increased, and he was seized with a violent palpitation. He forced his way back to the window, exclaiming, "Water, for God's sake!" His wretched companions again gave way, and manifested a proof of tenderness and attachment to his person, that could scarcely have been expected in such dreadful circumstances. "Give him water," they cried; and though raving in agony, none of them would touch it until he had drank. Being somewhat relieved, the palpitation ceased; but finding that water increased rather than diminished his thirst, he abstained from it, and moistened his mouth by sucking the perspiration out of his shirt-sleeves, or catching the drops as they fell from his head and face.* The rest having also discovered the pernicious effects of water, now grew clamorous for "air;" and the most opprobrious abuse was repeated upon the Soubah, his officers, and the guard, in order to force them to fire. A general prayer was then directed to heaven to put a period to their misery. They now began to drop on all sides. Many died standing, being upheld by the crowd around them; and the steam which arose from the living as well as the dead, was so pungent and insufferable, that all who could not approach the windows were suffocated. Mr Holwell had again retired; and stretching himself by the side of the Rev. Mr Jervis Bellamy, (who, with his son, a lieutenant, lay dead in each other's arms,) where he remained deprived of sense, and to all appearance lifeless, until daybreak. Being then discovered by his surviving friends, he was removed to the window, where the fresh air revived him. The Soubah having been at last informed of the havoc which death had made upon his miserable victims, sent to inquire if the chief was still alive, and upon Mr Holwell being shown to the officer, an order came immediately for their release. Of the 146 that entered alive, 23 only returned, and most of them in a high putrid fever. Even their deliverance, however, was dictated not by pity, but by avarice; for the Soubah had received intimation that Mr Holwell knew of a considerable treasure which was secreted in the fort; and it was for the purpose of questioning that gentleman upon the subject, that he summoned him into his presence. Mr Holwell, however, solemnly declared that he knew of no such deposit; but the inhuman tyrant would give no credit to his protestations, and ordered him, together with three of his friends, to be loaded with fetters, and conveyed to the Indian camp, about three miles distance. Here they lay all night, under a heavy rain, and were marched back next morning to Calcutta, exposed to the scorching beams of a tropical sun. They would infallibly have sunk under their affliction, had not nature expelled the fever in large painful boils, which overspread almost the whole body. In this condition, they were carried in an open boat to Moorshedabad, the capital of Bengal, about 100 miles up the Ganges, where, after enduring the most cruel and opprobrious treatment, they were set at liberty, through the mediation of the Soubah's grandmother When the order was given for their release, some of the courtiers represented to the Soubah that Mr Holwell was still able to pay a considerable ransom; he replied, with some marks of compunction, "if he has any thing left, let him keep it: his sufferings have been great; he shall have his liberty." Having laid Calcutta in ruins, and dispersed its inhabitants, the Soubah stationed a strong garrison in the fort, and returned to his capital. This cruelty, however, was soon to be retaliated upon its inhuman author. In the following year, Admiral Watson and Colonel Clive retook Calcutta; and the latter officer having defeated the Indian forces at Plassey, marched to Moorshedabad, when Saraja Dowlah was deposed, and soon after put to death. His successor having entered into a firm alliance with the British, paid a vast sum to the Company and the sufferers at Calcutta, as an indemnification for their losses; and the trade of this city being relieved from the high duties which had been formerly imposed upon it by the native princes, increased so rapidly, that Calcutta soon became the most flourishing European settlement in India. About twenty years ago, during a famine, the population of this city was estimated at 500,000; but, according to Lord Valentia, it now amounts to nearly 700,000. North lat. 22° 33′, East long. 88° 28′. See Rennel's *Memoirs;* Tennant's *Indian Recreations*, vol. i. p. 37, &c.; Lord Valentia's *Travels*, vol. i. p. 235, &c.; *A Voyage to India, China, &c.* in 1803–1805, in Phillip's *Coll. of Voyages, &c.* vol. v.; and Foster's *Travels*, vol. i. p. 9. (*p*)

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* In his despair of obtaining water, this unfortunate gentleman, we are told, had attempted to drink his own urine, but found it intolerably bitter; whereas, the moisture from his body was soft, refreshing, and pleasant

CALDERWOOD, DAVID, a celebrated divine of the church of Scotland, was born, as appears from Baillie's Letters, in 1575. He was, from his earliest years, destined for the ministry: and accordingly his attention was peculiarly directed to the study of divinity, in which, while yet a very young man, he had made the most respectable attainments. He wisely devoted a large portion of his time to the investigation of sacred scripture in the original languages, and in this investigation, he did not despise the aid which was afforded by critics and commentators. He also read the works of the Fathers, and the best books which could be found on the ancient and modern history of the Christian church. The learning which he had acquired procured for him very general respect; and his zealous attachment to the church of Scotland, which at that time was of the Presbyterian form, rendered him extremely acceptable to most of its faithful ministers. About the year 1604, he was settled at Crailing, in the neighbourhood of Jedburgh; where, by his private virtues and public fidelity, he recommended himself to the love of his people, and to the reverence of all who knew him. It was while in this situation that he gave the first decisive proof of his dislike to Episcopacy, and of his determination to adhere stedfastly to to the ecclesiastical system which he had embraced. James I. of Great Britain, with his characteristic bigotry and imprudence, endeavoured to bring the church of Scotland into a conformity with that of England: and with that view, he sent the Earl of Dunbar, then lord high treasurer, accompanied by three divines, to reconcile the ministers and laity to the projected change. These tyrannical and insidious attempts of the monarch, experienced the most vehement opposition; and none was more eager and resolute in opposing them than Mr Calderwood; for when the Bishop of Orkney came (1608) to visit the Presbyteries in Merse and Tiviotdale, he, along with Mr Johnston of Ancrum, solemnly declined his jurisdiction under form of instrument. The perseverance of the king, aided by the corrupt influence and subtile policy of his agents, was at length successful. Mr Calderwood however, continued to bear his open testimony, and employ his best endeavours against those despotic and illegal measures which were successively adopted to accomplish the royal scheme. And as he was not tempted by those preferments which a man of his talents and influence might reasonably have expected under the new ecclesiastical regime, so neither was he induced by the threatenings and persecutions to which he was soon after subjected, to abandon the principles and the conduct which he had hitherto maintained. Of the Assembly held at Glasgow in June 1610, and of that held at Aberdeen in August 1616, he explicitly declared his disapprobation, because they acted under undue influence, and were guilty of unconstitutional proceedings. When the king held a parliament at Edinburgh in May 1617, there was also a meeting of clergy assembled at the same time, to hear and consult with the bishops, evidently by way of imitating the convocation in England. Mr Calderwood went "to try what the ministers there convened were consulting upon;" and, in allusion to what was passing, boldly stated, that he could not look on that meeting either as a General Assembly. or as bearing any resemblance to the English House of Convocation, reminded them of their hostility to the church, and of their violation of promises made in its favour; and when interrupted by two members, he left them with these words, referring to their proposals about augmentation of stipends, "*It is absurd to see men sitting in silks and satins, and to cry poverty in the kirk when purity is departing.*"

The parliament having assumed the prerogative of regulating the ecclesiastical as well as the civil affairs of the kingdom, a considerable number of the ministers resolved to give in a protestation against this encroachment on their peculiar rights. Mr Archibald Simpson was appointed to draw it up, and to sign it on behalf of the ministers who had proposed or acquiesced in the measure; he received as his warrant and justification, a separate roll which contained their individual subscriptions, amounting to no fewer than fifty-five. This protest was presented by Mr Simpson to the clerk register, but he refused to read it before the states in parliament. A copy of it is given in Mr Calderwood's printed *History of the Church of Scotland:* and though it is sufficiently respectful in its form and language, yet it breathes such a spirit of dissatisfaction with the conduct of parliament, so plainly accuses the king of having acted contrary to his engagements, and so calmly and resolutely refuses to yield obedience whatever the consequences might be, that it could not fail to offend and irritate a prince so fond as James was of arbitrary power both in church and state. Accordingly Mr Simpson was summoned before the High Commission Court, and requested to produce the list of names with which he had been entrusted, that steps might be taken for punishing the most refractory of the protestors. The list had been given to Mr Calderwood, who was therefore ordered to appear before that court, at St Andrew's, to exhibit the roll there, and to answer for his seditious and mutinous conduct. He obeyed the summons, and appeared on the day appointed. The king attended in person, and behaved with his usual arrogance, officiousness, and severity. He entered into a dispute with Mr Calderwood respecting the merits of the protestation, and the part which he had taken in that transaction. He dogmatised about the rights of a General Assembly —illustrated the duty of obedience by the language of the Centurion in the Gospels—pressed Mr Calderwood to conform, by the use both of promises and threatenings—swore by his *gude faith*, that he was a very knave, like the rest of the false puritans, who were ever playing with equivocations;—and finding that the object of this abuse was too firm to be drawn aside from his integrity and his duty, and a more acute disputant than a royal personage could safely encounter or patiently brook, he ordered him to be sent prisoner to the tolbooth of St Andrews, from which he was afterwards removed to that of Edinburgh. The privy council then directed him to banish himself out of the king's dominions before the following Michaelmas, and not to return without licence. On giving security farther, he was allowed to go back to his own parish, but forbidden to preach: And after an application on the part of Lord Cranstoun, who was his security, to have the punishment changed into that of confinement to his own parish, which was unsuccessful, because he would not acknowledge an offence of which he had not been guilty, or make promises which his conscience would not allow him to fulfil, he at length retired into Holland, in which country he remained for several years. Having contrived to get his departure deferred till the month of August, 1619, he took the opportunity afforded him by this delay, of writing a book called *Perth Assembly*, which was condemned by the council in the December following, when happily the author was out of their reach. Thomas Cathkin, printer in Edinburgh, was cited to London on a charge of having printed this work. The following is a part of his examination, on the 13th of June 1619, before the king and some of the bishops. "*Has not Mr David Calderwood lived and been entertained at your house?*" said James. "*He wold not,*" answered Cathkin, "*resave anie entertainment from me, and did ly verie rarelie with me.*" King, "*Did he not ly at your house since he was banisched?*" Cathkin, "*Please your majestie, verie rarelie.*"—King, "*Hald up your hand, and say, as ye shall answer to God, how short time is it since you did speak with Mr David Calderwood?*"—Cathkin, "*Your majestie does striat me verie hardlie. I must needs gather my memorie before I cann tell your majestie.*" "Then," says Cathkin, "the king did swear I was going to equivocate; but presentlie I did remember myself, and said, I did speak with him within these fifteen dayes. We have found the ——; let us hald us here: forsooth Mr David Calderwood is a good brother and an goodleir father. With this his majestie did rise in a great rage, leaned on a table hard by; and presentlie did sitt down again, and said unto me, "*Traitor, thief, how durst thou receive my rebell?*" Cathkin, "*He was not your majestie's declared rebell.*" King, in grit rage, "*Did thou not know that I banisched him?*" I being so dasched with his majestie's wrath, forgat to tell his majestie that Mr David had gotten an oversight."

During his exile in Holland, he produced in 1623, the *Altare Damascenum*. This book is a refutation of Linwood's Description of the Policy of the Church of England. It treats, however, not only of the particular subject brought under discussion by that work, but also of the general questions at issue between Presbyterians and Episcopalians, and endeavours, by the help of much learning and of many arguments, to demonstrate, that the system of the former rests upon a foundation to which that of the latter has no just pretensions. It attracted great notice when it appeared; and while it gave high satisfaction to those whose opinions it supported, it gave equal uneasiness and displeasure to those on the opposite side of the controversy, though all united in acknowledging its erudition and ability. King James himself read it, and at once admired it for its lore, and disliked it for its success. It is said that a prelate observing him somewhat pensive and surly after perusing it, besought his majesty not to trouble himself, for it would be answered; but that the king passionately replied, "*What the Devil! will you answer, man? There is nothing here than scripture reason and fathers.*" It long continued to be a sort of armoury to the non-conformists, and it is often referred to and generally applauded by writers of that class. In the present day, however, it is not held in such high esteem; though certainly none can be said to be very deeply versed in the subject which it so ably discusses, to whom its pages are not more or less familiar.

It is not generally known that the *Altare Damascenum* is an enlargement, in Latin, of a work which Mr Calderwood wrote in English, and published in 1621, under the title of *The Altar of Damascus, &c.* This work, indeed, is extremely rare. The copy of it which we have seen, is in the possession of a gentleman in Edinburgh, and is the only one which we know to exist. It concludes with noticing a rumour spread by bishop Spottiswood, that Mr Calderwood had turned Brownist; which rumour it denies in strong language, and with bitter reflections upon the bishop. "If either Spotswood," says Mr Calderwood, "or his supposed author, persist in their calumny, after this declaration, I shall try if there be any bloud in their foreheads."

A curious attempt was made in the year 1624, to bring Mr Calderwood into disrepute, and probably through him to lessen the popularity of his ecclesiastical system. Mr Calderwood had been long sick, and as no accounts of him were received for a considerable time, people generally concluded that he was dead. Taking advantage of this belief, one Patrick Scott, a gentleman near Falkland, who had wasted all his patrimony in dissipation, and was ready to serve the court in any thing for a reward, took it upon him to write and publish a recantation, in the name of Mr Calderwood. It is asserted by Mr Calderwood himself, upon what authority he does not say, that the king furnished Scott with the matter, which he put into the pretended recantation. One is almost tempted to believe this meanness of a king, who had already been guilty of measures as despicable, and who could scarcely desire any thing more earnestly, than the disgrace and defeat of the Presbyterians. What followed, however, was still more criminal, though not more successful. When it was discovered that Mr Calderwood was alive and disclaimed the recantation, the infamous Scott, whether instigated by the king or not, cannot be known, went over to Holland, and sought for the innocent object of his vengeance, with an intention to assassinate him. In this diabolical purpose, however, he failed; for Mr Calderwood had, in the mean time, privately returned to his native country.

Mr Calderwood was the author of several works besides those which we have mentioned, on the transactions and controversies of the times. Of these, we cannot pretend to give a complete list; but the following may be considered as the greatest part of them: *The Speech of the Kirk to her beloved Children; the Confutation of Dr Mitchelson's Reasons for Kneeling; The Course of Conformity; An Epistle to a Christian Brother; A Dispute against Communicating where there was Kneeling, confusion of Gestures and Actions; The Antithesis be-*

tween the Pastor and the Prelate; A Defence of the Arguments against Kneeling at the Sacrament; Queries concerning the State of the Church of Scotland; An Exhortation of the particular Kirks of Christ in Scotland, to their Sister Kirk in Edinburgh; De Regimine Ecclesiæ Scoticanæ brevis Relatio, or Hieronymi Philadelphi De Regimine Scoticanæ Ecclesiæ Epistola; Ejusdem Vindiciæ contra Calumnias Joh. Spotswoodi; The Solution of Dr Resolutus's Resolutions of Queries and Exhortations. Several of these works were printed in Holland; and when they were about to be imported into Scotland, a proclamation was made at the cross of Edinburgh, bearing, that certain persons were attempting to bring into the kingdom a number of seditious and treasonable books, and commanding all ships coming from the low countries to be carefully and diligently searched, that the said books might be examined and condemned. This attempt, however, to accomplish by violence what could not be so easily obtained by argument, fortunately did not succeed; for Mr Calderwood's books were safely landed some days before the vessel containing them could be searched.

Mr Calderwood employed himself with great diligence and success in collecting and digesting, according to the order of time, all the memorials which could be procured relating to the ecclesiastical affairs of Scotland, from the beginning of the Reformation down to the death of King James VI. We are told by Baillie, that a great part of a session of the assembly in 1648 was spent in encouraging Mr Calderwood to perfect his church history, and that they agreed to give him out of their funds no less than 800*l.* Scots yearly, to enable him to proceed with it. This valuable work is still in manuscript. There are four copies of it. One of them is in the college-library of Glasgow; another is in the advocate's library of Edinburgh; a third is in the possession of General Calderwood Durham of Largo, who is the representative both of the family of Mr Calderwood, and that of the pious Mr James Durham, minister of Glasgow; and the fourth belongs to the General Assembly of the Church of Scotland, to whom it was presented by Mr Wodrow, having been carefully transcribed from the original manuscript under his own eye.

Every person who is at all acquainted with the productions of those who have written on the Scottish Reformation, must be aware of the importance and utility of Calderwood's manuscript volumes; and it is matter of regret, that the expenses necessarily attending the publication of them would be so heavy as to render that a very difficult and hazardous undertaking. We cannot refrain from suggesting, that enterprises of greater risk have been attempted in the literary world by subscription, and have succeeded. From this large work an extract has been published, under the title of *The true History of the Church of Scotland.* The matter is important, but the style is homely and uncouth. It must be observed, however, that this was not drawn up, as is generally believed, by Mr Calderwood himself, whose compositions are quite superior in every respect; it is the production of one of the ministers who lived in the time of the persecutions which took place under the reign of Charles II. Many copies of the work, indeed, will be found with the date 1704: but this is a device of the publishers, who were accustomed at that period to renovate a book merely by giving it a new title page. The title page, too, it should be noticed, bears, that the work was written at the appointment, and received the countenance of the General Assembly; whereas this applies not to the printed, but the manuscript history of Mr Calderwood.

The exact period at which Mr Calderwood returned from Holland is not ascertained. It is probable that he did not return till towards the year 1636, no mention being made of him in any record of ecclesiastical transactions in this country previous to that date. He lived for some time as privately as possible. His residence was chiefly in Edinburgh, where he equally opposed sectarianism, and encouraged non-conformity. Though he was not a member of the General Assembly held that year at Glasgow in 1638, when Episcopacy and the late innovations were condemned, yet it appears that he took a part in its proceedings, lodging secretly beside the moderator's chamber, and writing papers, which were afterwards read in court, in defence of the rights of ruling-elders to sit as members of Assembly. He also appeared in the Assembly in 1641; and, though no member, delivered his opinions upon the business with so much freedom and keenness, that the commissioner commanded him to be silent. The moderator, however, took occasion to mention his great services to the church—to regret that he had been so long neglected—and to recommend him to the "first commodious room." Mr Baillie remarks, that his promotion was not likely to take place soon, because he had, by his misconduct on this occasion, given great offence to his former benefactors and patrons. It was not very long, however, after this, that he received the church of Pencaitland, in East Lothian; but at what precise date cannot be determined. The authors of the *Biographia Britannica* affirm, that he was minister there in 1638; and, in proof of this, refer to the preface to the last edition of his *Altare Damascenum.* But neither in that preface, nor in any other printed document, is there any allusion whatever to the fact. Mr Calderwood was nominated, along with Mr Henderson and Mr Dickson, by the Assembly, 1643, to prepare a Directory for Public Worship. Indeed, when any thing of importance in the way of writing was required, Mr Calderwood was almost always employed; because, as Baillie observes, he was their "best penman." He continued to take an active part in ecclesiastical affairs during the remainder of his life, regularly attending the meetings of Assembly, expressing his sentiments on the various subjects which came before them, and frequently giving offence by what was deemed a "rude and humorous opposition." He seems to have been particularly anxious to guard the church against the Independent system, to which he thought he observed an evident tendency in the principles and conduct of many of his brethren. It was this which made him cry out so vehemently against sectaries and prayer-meetings; and the same anxiety it is evident, induced him to find fault, in 1645, with the Westminster Assembly, for asserting the divine right of kirk-sessions, and thereby conferring on the congregational eldership the power which properly belonged to presbyteries; and also to insist, in the assembly 1649, that, according to the second Book of Discipline, "the election of ministers should be given to the presbytery, with power to the major part of the people to dissent, upon reasons to be judged of by the presbytery." This proposal, which appears to contradict his doctrine in the *Altare Damascenum*, was rejected by the assembly; and an act of a different description passed in spite of all his reasoning. On this occasion, he introduced the practice, since become common, of dissenting from the decision of the assembly, and requiring the dissent to be registered.

Mr Calderwood did not long survive this. When the English army were in Lothian, he went to Jedburgh (1651), where he was taken ill, and died at the age of 76. He was a man of unquestionable piety and learning. His writings afford evidence of both; and our Presbyterian church is much indebted to him for the zeal and ability with which he defended her in the hour of danger. His Latin, though not elegant, is tolerably correct; and some of his English compositions are equal, if not superior, to any of the times in which he wrote. Calderwood's *True History of the Church of Scotland*; Spotiswood's *History of Do.*; Baillie's *Letters and Journals*; *Biographia Scoticana*; and *Unpublished MSS.* in the possession of the Rev. Mr M'Crie, Edinburgh. (τ)

CALEA, a genus of plants of the class Syngenesia, and order Polygamia æqualis. See BOTANY, p. 288.

CALEANA, a genus of plants of the class Gynandria, and order Monandria. See BOTANY, p. 312; and Brown's *Prodromus Plant. Nov. Holland, &c.* p. 329.

CALECTOSIA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 190; and Brown's *Prodromus Plant. Nov. Holland, &c.* p. 263.

CALEDONIA, in ancient geography, a famous country situated in North Britain. Its precise limits are not known, though antiquaries are fond of extending the appellation to the whole of modern Scotland. Henry, Chalmers, and many more, gravely inform us, that Agricola entered Caledonia by Carlisle and Anandale, without informing us upon what authority they so denominate the southern districts. We know from Xiphilin, that, in the 3d century, the Mæatæ and Caledonians were the two most powerful nations of Britain; and that of the two, the Caledonians occupied the more northern situation, while the other bordered on the Roman province; both of them, however, occupying barren mountains and savage plains. Ptolemy, in the second century, places the Caledonians in the most mountainous district of Scotland, making them to extend from the Lelamonius Sinus, supposed to be Lochfine, as far as the Murray frith; thus assigning them all that central country composed of the higher districts in the counties of Perth, Angus, Moray, Inverness, and Argyle. The information of Ptolemy seems to have been collected with great care, as he enumerates the smaller nations by whom Caledonia was on all sides surrounded, together with the towns, rivers, and promontories of the country. With both these authorities, Tacitus, in the first century, by far the best informed of all the writers who have taken notice of the Caledonians, perfectly coincides in placing that most renowned nation considerably to the north of the Forth and Clyde. A bare inspection of this author's journal of his father-in-law's campaigns, will make it perfectly evident, that the Romans had conquered all the nations to the south of the two great æstuaries; that they had crossed that of the Clyde, and conquered several tribes of Dumbartonshire and Cowal; that they had crossed the Forth, advanced far into Fife, nay probably had reached the Tay, before they had so much as seen the Caledonians. It was only in the seventh campaign of Agricola, and the fourth after that general had entered the supposed Caledonia of the antiquaries, that he first came in contact with these terrible mountaineers, when they surprised and nearly destroyed the ninth legion. This conflict took place beyond the Forth, and several days march after leaving Agricola's line of forts; and yet it was on this occasion that the Roman soldiers, now recovered from their terror of the so much vaunted Caledonian arms, and flushed with their success in this first encounter, for the first time demanded, "penetrandam Caledoniam," to be conducted into Caledonia itself. The highest authorities, therefore, historical and geographical, and the only authorities that can be attended to, because formally treating of the subject, concur in restricting the limits of Caledonia to the fastnesses of the mountains. It is no doubt convenient for particular theories, that twenty-one nations should be palmed upon us under the same general name, and that a disposition should thus be produced in the mind to consider them all as of the same family; but that writer must be pitifully addicted to system that would oppose, to the direct authorities now cited, the vague epithet of a poet, or the casual expression of a declaiming rhetorician.

It is remarkable, that Tacitus, in his Life of Agricola, uniformly mentions this nation by the general name of "Britanni," and of "the tribes inhabiting Caledonia," but never calls them Caledonians. Subsequent authors give them the appellation of Caledonii and Caledones. According to Cambden, the name Caledonia is derived from the Welsh *kaled*, denoting hard, rough, uncivilized. Buchanan traces it to the word *calden*, or hazel, which gave its name to Duncalden or Dunkeld, whence the country might have received its denomination. Mr Chalmers, in his late interesting work, deduces it from the British Celyddon, woody, mountainous, wild. For our own part, after all the etymologies which we have seen, we are disposed to think that none is so consistent, either with the sound or with the sense, as that which comprehends the name by which the inhabitants of Caledonia call themselves to this day. The word Gaël, as every one knows, is merely a modern and vulgar contraction for Gaidheil, Guydheil, or Gatheil, in all which forms it occurs. In a most ancient fragment, preserved by Innes, the Scots are called Gadeli. The Irish still call the Highlanders, Guydheil, and the Welch give them the name of Gwyddil, a term which the same people applied to the Picts of old, calling them Gwyddil Phicthi. Gadeldoine, or Gael-men, therefore, is as nearly represented by Caledonii, as could be expected from Roman pronunciation. According to Mr Chalmers himself, the name Gwyddil has always been applied by the British to the inhabitants of mountains; and is synonymous with his own Celyddoniaedd.

The fame of the Caledonians had reached Rome long before the arrival of Agricola in this island, though that general was the first who actually came in contact with them. After having, in the preceding campaigns, conquered the country south of the Forth and Clyde, secured his conquests by establishing a line of forts between these two rivers, and conquered several nations till then unknown, on the northern shores of the western æstuary, Agricola, in his sixth campaign, resolved to invade the "powerful states," as Tacitus calls them, "beyond the Forth." This expedition was conducted both by land and sea, the army marching along the coast, and the fleet, by way of precaution, attending them. Having proceeded in this order for many days, along the shores of Fife, engaging in frequent actions with the natives, and conquering the country, they seem to have established themselves in these quarters for the winter; for we may gather from Agricola's speech, that the action of the ninth legion happened the summer preceding the great battle, which was on the eighth year of Agricola's wars in the island.

Whilst the Romans were thus engaged in the conquest of Fife, Stirling, and the lowlands of Perth and Angus, distracting the attention of the natives by the manœuvres of their fleet along the coast; the tribes of Caledonia took the alarm, entered into a formidable confederacy, and were reported to be actually on their march from the westward to attack the line of forts in the rear of the Romans. The tribes inhabiting Caledonia, says Tacitus, rising in arms with a vast preparation, increased by fame, *uti mos est de ignotis*, as is the case concerning unknown nations, being reported to have attacked the forts, inspired the greatest terror as having commenced offensive operations. Many of the Romans were accordingly now for returning to this side the Frith of Forth, *regrediendum citra Bodotriam*, lest they should be disgracefully driven back by this new enemy. But Agricola, no ways intimidated, dividing his army into three divisions, marched during the seventh campaign across the country, from the eastern coast, to prevent their attempts upon his fortifications on the isthmus. The Caledonians perceiving they could not cut him off from his lines, suddenly changed their plan, and falling unexpectedly with their whole force upon the ninth legion, in the night time, nearly overwhelmed it. They were already within the camp; but Agricola, informed of their route, had previously dispatched the swiftest part of his troops, horse and foot, to harass their rear. In the mean time, he himself proceeded by forced marches to the relief of the legion, and the Roman standards appearing at the break of day, and the Britons being attacked in front and rear, a dreadful conflict ensued in the gates of the camp. The Caledonians were thus compelled to relinquish their prey, and made the best of their way into the fens and fastnesses. Those of the Romans who were formerly terrified at the approach of these formidable and new antagonists, and wished to retreat, were now so elated by this victory, that flying into the opposite extreme, they were for penetrating directly into Caledonia. We are not informed what were the further achievements of Agricola this summer, nor where he quartered his troops during the winter. His next appearance in the field, was in the following year, towards the end of summer, when the great battle of the Grampians took place, being the eighth year since his arrival in Britain, and the 85th of the Christian æra.

The Caledonians, no ways disheartened by their late failure, had spent the remainder of that season in preparing for the succeeding campaign, by providing places of retreat for their wives and children in case of an invasion, arming and organizing their youth, forming alliances which they ratified with religious rites, and holding consultations and councils, in which they mutually exasperated each others minds against the common enemy; and having arranged these matters, they separated for the winter. When Agricola took the field, he at the same time sent his fleet along the coast, which, by making frequent descents and predatory excursions into the country, might distract the attention of the confederates. These, however, were not deficient either in zeal or conduct. Mustering probably the whole of their forces, to the amount of 30,000 combatants, they awaited towards the end of autumn, the attack of Agricola at the foot of the Grampian mountains. This army consisted of the flower of their youth, and of men inured to war, commanded by their greatest chiefs, each bearing his trophies and his badges of honour. Among these Galgacus, as being pre-eminent in valour and lineage, held the chief rank, and acted as commander. The Caledonians were drawn up on the face of a hill, one line rising above another from the plain, thus making a magnificent as well as terrible display of power to their enemies. The level grounds in front were scoured by their cavalry, intermixed with armed chariots. The Romans, on their side, were drawn up with consummate skill; 8,000 foot auxiliaries composed the main battle; 3,000 cavalry protected the wings; while the legionaries, probably consisting of as many more troops, were stationed in the rear—a bulwark, says Tacitus, in case of a repulse, an honour to the leader should he be able to render unnecessary the effusion of Roman blood. After an energetic speech from each of the generals to their respective armies, the light troops, on both sides, began the battle by a general discharge of their javelins. The Caledonians, while at a distance, displayed much address in avoiding and parrying these with their small bucklers and huge swords, while they at the same time overwhelmed their antagonists with showers of darts; but they could not withstand the close onset of some German heavy armed foot, who drove them up the hill sword in hand. The other cohorts, following the example of these Germans, fell upon the whole front of the Caledonians, and threw their horse, infantry, and chariots, into inextricable confusion, and a terrible slaughter ensued. In the mean time, however, the Caledonians on the higher grounds made a stout effort to turn the enemy, and attack them on the flanks and rear; but the Roman cavalry observing this movement, attacked these insulated bodies on all sides, and put them to the rout. Though the day was now irrecoverably lost, and the Caledonians retreated in all directions, yet the fight was kept up with great obstinacy, and the foremost of the Romans paid dear for their temerity. In this great battle, so honourable to the valour of our ancestors, 10,000 of the Caledonians, by the Roman accounts, remained upon the field, while the enemy are said to have lost but 350 men; a return in which it is probable the legionaries only are included.

The Caledonians had committed a great error in giving Agricola battle at that late season of the year, when they might easily have starved him out of their country; but this might proceed from their not being aware of the discipline of the Romans. Though unfortunate in this trial of their strength, they did not, however, tamely yield to their conquerors. Immediately after their defeat, they adopted the politic measure of laying waste their country, and burning their houses and effects, to deprive the Romans of all means of subsistence. It is even added, that they put to death those of their wives and children whom they could not carry away, to prevent their falling into the enemy's hands. The probability is that Roman vanity has greatly exaggerated the loss of the Caledonians. One thing, however, is certain, that Agricola retreated immediately after the battle, owing, according to Tacitus, to the lateness of the season, but more probably to the danger of wintering among these hostile and high spirited tribes. Agricola withdrew his army by slow marches, intending by that means to display to the new nations the severe loss sustained by the Caledonians, as not being in a condition to molest his retreat; and, having exacted hostages of the Horesti, supposed to be the inhabitants of Fife, he sent his army into winter quarters, probably in the districts to the south of the Forth and Clyde. It was during this campaign that Agricola ordered his fleet to circumnavigate the island, in order to terrify the tribes of the north with the greatness of the Roman power.

As a proof that the Romans had hitherto acquired but a momentary footing on the frontiers of Caledonia, we have only to consider the state of things in A. D. 121, 36 years after the battle of the Grampians, when we find Hadrian building a wall between the Tyne and the Solway, to restrain the incursions of the Caledonians, and of their allies the Mæatæ, a new denomination of people, who seem to have inhabited the country near Agricola's lines. About 17 years thereafter, the Mæatæ being vanquished in several engagements, by Lollius Urbicus, their country was again occupied by the Romans, and the lines of Agricola were fortified anew, with a rampart and ditch. This defence, thenceforward called the wall of Antoninus, because built in his reign, was intended as the boundary of the empire; but the Caledonians in 180 broke through it, and being joined by the Mæatæ, carried fire and sword into the Roman province. We find the same confederates again in 198 pursuing the same career of rapine and desolation; when Lupus, the general of Severus, not being able to make head against them, had recourse to the dangerous expedient of bribing them to return, and ransoming their prisoners. This, as might be expected, was but a temporary remedy. The Caledonians renewed their ravages with more fury than ever, so that the presence of Severus himself became necessary. His arrival, in A. D. 207, with a powerful force, so alarmed the confederates, that they sent ambassadors to the emperor to propose an accommodation; but their offers were rejected. Severus, with an immense army, took the field in person, resolving to penetrate to the furthest extremity of the island, and put an effectual period to the power of the Caledonians. Our ancestors, taught by their former experience, adopted on this occasion a mode of defence peculiarly suitable to their circumstances, and allowed the enemy to waste his strength in contending with the natural difficulties of the country. Severus, we are told, employed in this expedition a great part of his troops in cutting down the forests and draining the marshes, in which the natives suddenly disappeared when pursued by the Romans, and in constructing roads and bridges for the conveyance of supplies; the remainder of his forces he employed in protecting the workmen from the incessant attacks of the Caledonian skirmishers. These never appeared in a body, but contented themselves with hanging on his line of march, and intercepting his supplies, and with desultory attacks and ambuscades, by which the enemy suffered excessively. The emperor lost in this expedition no fewer than 50,000 men, without a single battle, and even without having seen the enemy in a body. Severus, however, by the most incredible perseverance, at last penetrated into the heart of the country, which probably had never till then seen a foreign enemy; and compelling the Caledonians to lay down their arms, deprived them and the Mæatæ of a part of their territory. The dear bought success of this expedition was unquestionably not adequate to the original intention of Severus, for upon withdrawing his army to the south, we find him employing his troops, for the space of two years, in constructing his famous wall; a pretty strong symptom of that independence still maintained by the Caledonians! An additional confirmation of their remaining vigour is furnished by another war, A. D. 210, when the Mæatæ and Caledonians, two years after the last pacification, availing themselves of the difficulties of Severus, made a formidable attempt to wrest the ceded territory from his grasp. The old emperor, who was at York upon the arrival of this intelligence, gave orders for the utter extermination of the barbarians, without sparing the very infants in their mothers wombs. His death, however, prevented the execution of this cruel determination, and Caracalla, anxious to quit Britain, concluded a peace with the devoted nations. After this period little more is heard of the Caledonians; their name, in the pages of the Greek and Roman writers, falls gradually into disuse; and the population of their country, during the third century, begins to be known under the two celebrated denominations of Scots and Picts.

The Caledonians, according to the account of Tacitus, resembled the Germans in their large limbs, red hair, and blue eyes, differing remarkably in all these respects from the Silures, or inhabitants of Wales, who were of a darker complexion. They are represented by the writers of the second and third centuries, as having neither walls, towns, nor cultivated lands; subsisting by pasturage, hunting, and rapine, and on the wild fruits of their barren country. Hardy beyond belief, they are said to have gone naked, at least in battle, plunging, when pursued, up to the neck into their morasses, where they continued for several days without tasting food. In winter especially, and perhaps on all ordinary occasions, they must have used, like the southern Britons of Cæsar, the skins of beasts to protect them from the cold. They had a custom, in common with all the other natives of the island, of staining their bodies of a blue colour. This was done, at least in after times, with some degree of art, as the skin was punctured with a sharp instrument, and the colouring matter rubbed into it, so as to exhibit permanent lines and figures, in the manner of some of the South Sea islanders. The arms of the Caledonians were, a very long pointless sword, a small buckler or target, a short spear, having a knob of metal on one end, and a dagger. As far as we have read on the subject, they are not remarked as using bows and arrows. The covinus, or war chariot, used by the Caledonians, was probably armed with scythes and hooks, to cut down the ranks of the enemy. Upon the whole, the military apparatus of the Caledonians evinces a greater proficiency in the arts, than the writers of that period allow them. Their horses were small, but extremely active; and their infantry famous for their quick movements. The bravery and unsubdued spirit of our ancestors, whom the Romans could never bend to their yoke, and who, on that account, form a splendid contrast to the other nations of the world, are such as to give us just reason to glory in being their descendants, all barbarous and uncultivated as they were. Their manners seem to have been much of the same description as those of the southern Britons, before their subjugation by the Romans. Cæsar says of these, that every ten or twelve men had their wives in common, and that the children were accounted to belong to him who had first married the mother. Nearly the same thing is said of the Caledonians, only that in this case the children were brought up by the community, as being claimed by no particular man as their father. It has been ignorantly asserted, that the Caledonians had no houses, because they had no walls nor towns: Tacitus expressly tells us, that after the great battle, they set fire to their houses. We suspect that if there exist any of those circular fortifications, called by Mr Chalmers Pictish forts, within the proper limits of Caledonia, they must be accounted the work of a later period.* Both Dio and Herodian, as well as Tacitus, allow that Caledonia was inhabited by several distinct tribes. Of the Caledonian government, we know nothing more than that it was democratic, being probably a sort of federal union. Galgacus does not appear to have been a king; but merely a chief selected from many others, for his birth and talents, to conduct the operations of the campaign. (E)

CALEDONIA, (New), an island in the South Sea, and, after New Holland and New Zealand, the most considerable that has yet been discovered in it. This island was first seen by Captain Cook in 1772. His survey of it extended no farther than to its north-eastern parts. Twenty years afterwards, it was visited by M. D'Entrecasteaux, during his voyage in search of La Peyrouse, when a more extended observation was directed both to its coasts and to the interior. According to the account of the former of these navigators, it is situated between 19° 37′ and 22° 30′ Lat. S., and 163° 37′ and 167° 14′ E. Long. The position assigned to it by the latter is for the southern extremity, Lat. 22° 31′ S. Long. 164° 30′ E.; for the northern, Lat. 19° 58′ S. and Long. 161° 10′ E. Its length from S. E. to N. W. may be estimated at about 90 leagues; its greatest breadth does not exceed 10 leagues. The coast of this island is extremely bold, and difficult of access. Independently of the obstacle to an easy landing upon it, arising from the height and steepness of its own mountains, which, in some directions, extend even to the water's edge, it is on almost all sides environed with numerous rocks, islets, shoals, and sand-banks, which either form a continued chain, passing in the line of the shore, often at a considerable distance, and shutting it up completely from the open sea, or assuming the yet more dangerous aspect of numerous unconnected points shooting up irregularly from the surrounding deep. A principal chain of the connected rocks is that which skirts the south-east coast of the island, at a distance from the land generally of from two to three miles, still more in some situations, and thence proceeding, first in a southerly, afterwards in a westerly direction, to a distance from it of 20 miles or upwards. Towards the east and north, the islets and rocks appear chiefly in the more detached state just alluded to, forming as it were so many protuberances, issuing from the extended base of the principal summit in the island. The danger and the difficulty of navigation must in those parts, therefore, be peculiarly great, as many of these rocky points hardly rise above the level of the water; and they seem to extend outwards to a distance even beyond sight of land. The interruptions to this sort of irregular wall, if it may be so called, seem not to be considerable in any quarter round the whole compass of the island; or if the coast is any where left open to the sea, it is yet probable, that the environing bulwark of rocks is in such situations rather carried out to a greater distance, so as not immediately to come into view, than totally suspended. Several of these rocky excrescences are the production of a species of polypi. Some of them appear to be of a more permanent character, and of considerable magnitude. The Isle of Pines derives its name from the abundant growth upon it of that description of trees, which may hereafter prove an important resource for shipping, in a region generally so deficient as this is in such produce. The water around the coasts of this island is generally deep, and, as might be expected from the nature of the ground, abounds with fish, which the native, safe within the barrier of the surrounding rocks, can pursue with ease and success in the slightest canoe. The variation of the needle, as observed here and in the immediate vicinity, fluctuated chiefly between 9 and 10 degrees towards the east. The weather in those parts, during a course of from three to four months that a register was kept of it, seems to have been variable, most frequently moderate: The winds in May, June, and July, were chiefly from easterly points; but in the subsequent month, they were more from the west. The mercury in the barometer stood commonly from 28 in. 1 line and 4-10ths to 28 in. 2 lines and 2-10ths. The heat was felt to be excessive, but the degree indicated in Reaumur's thermometer was never higher than 25° on shore, and 21° at sea. The tides were observed only once a day, when the water rose in perpendicular height from four to five feet.

The general aspect of the island of New Caledonia is mountainous and lofty. A chain of hills runs through the whole extent of the island, in the direction of its greatest length, consisting of three distinct rows or ridges, the breadth of which, taken together, is not less than 20 miles. These lines rise above one another somewhat in the form of an amphitheatre, varying in elevation from 2000 to 6000 feet above the level of the sea. A detached mountain rises above all the others, being upwards of 7000 feet in height. The principal component parts of these masses, are quartz, mica, steatite more or less hard, green schorl, granite, specular iron-ore, &c. Garnets are also found, likewise layers of gold, serpentine, hornblende, and talc. This island differs from all the others which have hitherto been discovered in the South Sea, by being entirely destitute of volcanic productions. The soil upon the sides of the hills is principally a yellow clay; but this being commonly but to a small depth, and very much interrupted by deep ravines, rocky protuberances, and other obstructions, they seem for the most part to be little capable of cultivation, even in their lower parts. Nearer to the summits, the farther impediment is of course added, of an untoward climate, extremely cold, and subject to violent and blasting winds. Commonly, however, they are throughout their whole extent coated with coarse grasses and other plants, and here and there trees and shrubs. Trees rising, in particular, from the bottoms of the gullies, by which the hills are every where furrowed, agreeably relieve the eye amidst the general aspect of barrenness, which otherwise prevails. Some of the mountains are even covered with trees to their very tops; and, in general, those elevated lands are the copious source of numerous streams, which, gliding in all directions, and with every variety of appearance over the face of the hills, at once beautify and gladden the entire landscape, and hasten to convey to the subjacent plains, health, fertility, and the means of improvement. The comparatively low-lying grounds, not only for the most part prevail over the whole extent of the sea-coast, but stretch, in particular directions, to a great distance between the hills. The common soil of these plains is a sandy black mould. The mode of recruiting the strength of this land, by the application of manures, seems to be unknown; but the slower means of melioration, which consists in allowing portions of it that have been exhausted to remain for a time in a fallow state, is universally practised, and the ashes obtained afterwards, in consequence of burning the grass, which had thus been suffered to over-run the surface, may so far have the same effects, which in other countries are aimed at by the introduction of such foreign substances. The cultivation, in general, is conducted here with industry, and at the same time with considerable skill. As is usual in China, and in the higher parts of Asia Minor, soil, which otherwise would not be sufficiently permanent to ensure a crop, is secured and supported by means of little walls built under it, and the fruitfulness of arid spots is increased by leading into them streams of water. The combination and contrast, which is found in as great perfection here as in many other parts, between the bold and striking features of nature and the softer traces of art, open a scene sufficiently picturesque; consisting, on one hand, of the grand and imposing objects, both in the island itself, and scattered over the coast, which have been already enumerated; on the other, of winding streams, agreeable plantations, and straggling villages.

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* It is indeed remarkable, that the Roman and Greek writers make no mention whatever of sieges in the campaigns of Agricola and Severus in this country; so that the forts in question, if they then really existed, seem to have been totally useless as strongholds.

The vegetable productions of New Caledonia seem, in general, to be the same which prevail commonly in similar latitudes. Small clusters of fig, cocoa, or other trees, usually surround the different hamlets, or even single houses, serving at once for ornament and shelter. In one or two instances, there were observed thick forests of cocoa trees; but, upon the whole, these seem to be rather scarce in the island. The same may be said of the plantain and bread-fruit trees, particularly of the latter; of which, notwithstanding the attention that seemed to be paid to them where they occurred, but few specimens were seen, and those apparently of an inferior quality. Bananas, Caribbee cabbages, and other plants of the arum tribe, melaleuca trees, aleurites, and various plants of the proteæ and bignoniæ families, are mentioned among the productions that were observed here, as also some species of hibisci, acanthi, casuarinæ, and acrosticha. The commersonia echinata, a tree that is very frequent in the Moluccas, was noticed in the upper grounds. There is a species of hypoxis that grows here spontaneously. Sugar canes, sweet potatoes, and yams, also occur, together with a species of bean (*dolichos tuberosus*,) the roots of which are very much in request as an article of food. There were observed, moreover, some new or peculiar species, or varieties, as well in the vegetable as in the animal kingdoms. In the former may be distinguished some new species of figs, a peculiar fern, and a jasmine; a plant or two of the asparagi and the loti families; several species of limodorum, of passiflora, and of cerbera. In the latter we remark some uncommon pigeons, a beautiful species of magpie, with a species of fish belonging to the genus tetraodon of Linnæus, apparently of a poisonous quality. Till the arrival of Captain Cook at this island, the inhabitants appear to have been altogether unacquainted with goats, hogs, dogs, or cats. The animals of some of those kinds which he left in it they probably devoured or destroyed, as no vestiges of them were discovered by D'Entrecasteaux's people; and the existence or the properties of such animals seemed to be as much unknown to the natives as if they had never been seen amongst them. Some poultry appear to be raised here; but owing, probably, to the little attention paid to them, they are but few in number, and seemingly in a degenerate state.

The inhabitants of New Caledonia are a race of people robust, well made, active, and of features and an expression of countenance rather agreeable. The common stature, both of men and women, especially of the former, is above what we usually distinguish as the middle size. There were some instances of persons not less than six feet four inches high. The prevalent colour is somewhat between a copper colour and a jet black. The beards of the men, and the hair in both sexes, is usually strong, coarse, and very much frizzled. The practice prevails of pulling out the beard by the roots, though in some cases also it is allowed to grow long. The hair is worn in many different ways, sometimes tied up to the crown of the head, sometimes clubbed at the sides, sometimes cropped short, and sometimes the appearance of long hair is acquired by means of two or three artificial tresses, made commonly with the leaves of some plant of the grass kind, and covered with the hair of the vampyre bat. A kind of combs is in general use, consisting of several sticks of hard wood joined together, of about the thickness of knitting needles, and from seven to ten inches in length. For the greater convenience, these are commonly worn in the hair. Both the hair and the beard are generally of a deep black colour.

The men of this island wear little or no clothing. A kind of garments made of coarse matting was observed among them, but these they seldom used. Their ordinary dress consisted merely of a piece of stuff manufactured from bark, or of the large leaf of a tree suspended from the neck, and wrapt round the middle of the body. The dress of the women is a short petticoat, or fringe, formed by putting together filaments of the plantain tree to the thickness of six or eight inches, and not much more in length, which are connected amongst themselves, and fastened about the waist by means of a long string. Both in this article of dress, and in other respects, a good deal of attention is paid to ornament. With this view, the skin is dyed or punctured, the ears are perforated, and much finery is brought into use, consisting of ear-rings, necklaces, amulets, bracelets made of shells, stones, or other precious or esteemed substances. A piece of dress which seems to be most valued among the men, is a kind of concave cylindrical black cap, made of strong paper, which was supposed to be reserved exclusively for the chiefs and warriors.

The houses or huts raised by this people are of a circular construction, somewhat in the form of a bee hive. The framing is of small spars, reeds, or such like materials. The lower part of the huts is erected perpendicularly, to the height of three, four, or five feet, when the roof tapers off in a pretty regular cone, and is terminated by the upper end of a post fixed in the centre of the floor; the whole being covered, to the thickness of two or three inches, with a thatch made of coarse long grass. Some of these houses are surrounded by palisades, equal in height to their side-walls, and are decorated at top with carved work, or shells. The entrance into them is by an opening, which is commonly no more than sufficient to admit a person stooping. In the interior, more regard is had to convenience than to elegance, or even to neatness. The floors are laid with dry grass; and mats are spread for the principal people to sit or sleep on. Much use is made of fire in these houses, and the only outlet for the smoke is by the door; whence, being accustomed to an atmosphere at once gross and sultry, the inhabitants are extremely sensible to the cold of the open air.

The subsistence of the people of New Caledonia is chiefly derived from roots and fish; and almost their only household utensil is a sort of earthen jar, in which they prepare whatever part of their food is dressed by means of fire. This mode of living does not seem to indicate a very improved state of cultivation, even in those parts of the country which are in this respect farthest advanced. But as to the inhabitants of the mountains, they are obviously in a condition of the greatest misery, being without shelter from the severity of their climate, and in the utmost want of all manner of provisions. It is probably from necessity that some here have been led to eat a species of spiders which are found in the woods, nay, even to allay their hunger with a kind of earth called steatite. A certain enjoyment seems to be found by many in chewing the bark, or other parts, of particular plants. The common drink is water, which appears to be taken in a manner strangely uncouth and peculiar. The navigation of this people is less dextrous than that of several of the other islanders of the South Sea. The sort of canoe which they use seems to be peculiar to themselves, being a double canoe, formed by the junction, at the distance of about three feet asunder, of two distinct single ones. The mast is in the middle space betwixt both; and this clumsy and inartificial vessel is carried forward by means of one or two latteen sails, extended to a small latteen yard. A kind of fishing nets was occasionally, though rarely, seen among the people of this island, made of the filaments of the plantain tree, or of some similar substance. Hooks and lines seem to be unknown among them. Their chief method of catching large fish was by striking them with darts, in which practice they were very dextrous. It is principally the women that take the shell fish, in quest of which they wade out a great way into the sea, searching for them with pointed sticks, which they thrust into the sand.

The language that is spoken in New Caledonia is in some degree peculiar, but seems to be chiefly a compound formed from several of the languages prevalent in the different adjacent clusters of islands. A vocabulary of this language is annexed to the narrative of D'Entrecasteaux's voyage, published by Labillardiere. From the circumstance of a name for iron occurring in their language, there appears reason to conclude, that the metal is not unknown to the inhabitants of this island. It has not, however, been observed to be in frequent use, even for purposes for which it might have been employed most beneficially, in the manufacture of warlike instruments for example, or of implements of labour. The common hatchets are made of serpent stone; notwithstanding the hardness of which, they effect their objects with difficulty, and chiefly through the exertion of bodily strength. Yet did not implements of iron seem to be in much request here, less, indeed, than in any other of the South Sea islands.

The principal offensive weapons of the Caledonians are clubs, spears, darts, and slings, which they use with considerable art, and which are made commonly with much neatness, and even decorated often with a profusion of ornaments. The materials of which they are constructed are the same that are used for the like purposes in the neighbouring islands.

There is a material difference in the accounts given by the navigators who have successively visited this island, relatively to the character and manners of the inhabitants. In the narrative which we have of Captain Cook's voyage, they are represented as a people courteous, friendly, honest, and generally of a mild and innocent disposition. In the account given by the French navigators, numerous instances are mentioned of their thievish inclinations, of their cunning, and the artful arrangements adopted by them, with a view to the accomplishment of their schemes of pilfering, and, in some cases, of their audacity and shamelessness in effecting such objects, or in maintaining and defending the acquisitions so obtained. From various examples adduced of the actual fact, as well as of several circumstances expressive of their inclination, and of the means employed to gratify it, nay, even from the exhibition of the instrument appropriated precisely to this object, there seems reason to conclude, that they have no disrelish for human flesh; though probably this appetite is not indulged, except with a view to an imaginary heightening of the revenge upon their enemies, which numerous appearances in different parts of the country proved them disposed to exercise with the most unsparing fury and devastation.

The territory of New Caledonia is divided apparently into many districts, each governed by its own chief. There is some intercourse of war or of peace between these different principalities, but there has been as yet no such union as to have ever led to the denomination of the whole island by a common name. The authority of the several chiefs over their people seems not to be very considerable, at least their orders were by no means strictly attended to in any thing that concerned the European visitors of the country. As it was observed, however, that more attention was paid to their commands in any thing that respected their own particular interests, the greater indifference in the other case, might perhaps be rather a new proof of artfulness of character than of any real insubordination. We have no adequate data whereby to ascertain the populousness of this island, though the reasonable presumption, even from the prevalent nature of the territory, is, that it cannot be very considerable.

Female chastity is here in reputation, and is guarded with some strictness, though, perhaps, not so inviolably maintained, as might be concluded from the representations on this subject of those who first visited the island. In other respects, women are in a subordinate and servile state. It is they chiefly who cultivate the ground; and they are employed in all other sorts of drudgery and manual labour. The Europeans who visited New Caledonia, had some opportunities of ascertaining the state of music in the island, both vocal and instrumental. The only musical instrument observed here, was one formed of a piece of polished brown wood, about two inches long, shaped somewhat like a bell, with two holes in it near the base, and one at top, all communicating with each other; and by blowing into the uppermost of which, a sort of shrill whistling sound was produced. In the singing that was heard, the performers seemed to have some idea of time and measure, but their voices were harsh and discordant, and the effect altogether to an European ear was rather disagreeable, though to the natives themselves it appeared to afford considerable pleasure.

Of the religion of the people of New Caledonia, nothing is known. They deposit their dead in the ground. The burial places are generally in the vicinity of their dwelling-houses, consisting of small heaps of earth, raised a little, and covered towards the middle with a very open lattice work. Those in which their chiefs slain in battle are interred, are decorated with spears, darts, paddles, and such other insignia, emblematical either of a principal and important object of their lives, or of the manner of their death.

A sort of disease, somewhat of the nature of a leprosy, seems to be very prevalent in this island, the effects of which are exhibited in great swellings of the legs and arms, and a harsh, scaly, and sometimes blotched appearance of the skin. Much also is suffered from the vast swarms of musquitoes which hover every where around the coasts, and are extremely troublesome, both in the houses and in the fields. See Cook's *Second Voyage*, chap. viii. ix. &c.; and Labillardiere's *Account of a Voyage in search of La Perouse*, vol i. and ii. chap. vi. xiii. xiv. (K)

CALENDAR. See CHRONOLOGY.

CALENDER, in the manufacture of cloth, in its limited sense, is the name of a mechanical engine used for smoothing the surface of cloth, after it has undergone the previous operations of weaving, dyeing, or bleaching. In the more extensive and general acceptation of the word, among those who deal in cloth, a calender is a place where, besides smoothing the cloth, the operations of folding, papering, packing, and all others necessary to prepare it for exposure to sale, either in the home or foreign markets, are carried on.

For smoothing the superficies of cloth, two different modes are adopted: The first is merely that degree of compression which, besides divesting the threads which compose the texture, frees the cloth from any creases or folds which it has previously received, and renders the whole surface on both sides uniform and level. The second, besides effecting this, adds a gloss to one side of the fabric; the first is generally called dressing; the second glazing. A considerable diversity of apparatus is required for these purposes; representations of the most important and essential parts of which will be found in Plate CVIII.

The most simple and common way of smoothing the surface of cloth, and which in some respects combines the two modes of acting upon it, namely, by pressure and by friction, is the common domestic smoothing iron, which acts both by pressure and friction. In the operation of the smoothing iron too, besides the mechanical operation, the effect is found to be much heightened by moderate heat, probably from the expansion produced in the stuff of which the cloth is composed, during the operation. For the smoothing of large surfaces of cloth, the operation of the hand-iron being much too tedious, the implement generally employed for the use of private families, is the common *mangle*, of which there are different kinds in use. One very simple in construction, and which answers the purpose very well, is represented in Fig. 1. Plate CVIII. This machine consists merely of a strong level smooth table, of a convenient height and breadth, the cover being stout, and of well seasoned wood, to prevent casting or warping. The cloth being smoothly spread upon this table, the box A, which is placed upon two smoothly turned rollers of iron, is made to roll alternately from one end of the table to the other, until the cloth is sufficiently smoothed, when a fresh portion is spread upon the table, and the operation repeated until the whole piece has undergone the process. The cloth may be very regularly and quickly drawn along the table, by unwinding it from a roller at one end, and winding it upon a similar roller at the other. If it be desirable occasionally to employ heat, it may be easily done by casting the iron rollers of the box A hollow, and filling the cavity with small cylinders of cast iron, heated previously in a furnace or common fire. The motion is communicated to the box A by two belts, cords, or chains B, B, which, after passing over a pulley at either end of the table, are wound round the cylinder or barrel C. By turning a handle or winch W, the barrel is moved round, and the motion communicated to the box in either direction. It will be found convenient to have two hooks suspended over the box, by which it may be lifted from the table when the cloth is to be shifted.

An apparatus of this kind may do very well for family use, or upon a small scale; but it would be found too trifling and tedious for the operations of general business, where quantity and dispatch are necessary. For this reason, the common five bowl calender is generally used; and this machine is usually set in motion by the power of a horse, excepting in large manufactories, where the great moving powers, water or steam, are employed for a variety of purposes, in which case the calenders are driven by the same power employed for other mechanical purposes.

A front elevation of the five bowl calender will be found in Fig. 4. A is the frame-work, consisting of two very strong upright posts, generally of hard wood, about 12 inches by six, and connected at the top by a strong cross piece or cape, fixed to the upright posts by screw-bolts, besides which there is usually another cross rail below; secured in the same manner. The bowls or cylinders, five in number, are distinguished by numerals. Of these, numbers 2 and 4 are of cast iron, very smoothly turned, and hollow in the centre, for the purpose of admitting cylindrical pieces of iron red hot, when the calender is to be heated. The main bowl, or cylinder 3, used to be universally of wood, until the introduction of what are called paper bowls, which, we believe, originated in Lancashire, and which have been found in every respect so much superior to the former, that they are now in very general use, although the original expence of a paper bowl is at least six times as great as that of a wooden one. The advantage of the paper bowl over the wooden one, arises from its being perfectly free from every tendency to split or warp, to both of which the wooden one is very liable, especially when often exposed to great heat from the iron bowls with which it is in contact. Independent of this, which of itself is of infinite importance, the paper takes a very smooth fine polish when turned; and by pressing into every pore of the cloth, smooths its surface much more effectually than any cylinder of wood, however truly turned.

The construction of the paper bowls is simple although tedious, and may be very briefly explained. The axis of the cylinder is a square bar of malleable iron, of the proper length. Upon this is first put a strong round plate of cast iron, of the diameter intended for the cylinder when finished. A quantity of thick stout pasteboard is then procured, and cut into round pieces, rather larger in the diameter than the iron plate. In the plates, and in every piece of the pasteboard, a square hole must be cut in the centre to receive the axis; and the circle being divided into four or five equal parts, a hole must also be cut at each of the divisions, an inch or two within the rim. These pieces of pasteboard being successively put upon the axis, a long rod of malleable iron, with a head at one end, and screwed at the other, is also introduced through each of the holes near the rim, and this is continued until a sufficient number are thus placed to form a cylinder of the length required, proper allowance being made for the compression which the pasteboard is afterwards to undergo. Another round plate is then put on, and nuts being put upon the screws, the whole are screwed tight, and a cylinder formed. The cylinder is now to be placed in a stove, exposed to a strong heat, and must be kept there for at least several days; and as the pasteboard shrinks by exposure to the heat, the screws must be frequently tightened until the whole mass has been compressed as much as possible. When the cylinder is thus brought to a sufficient degree of density, it is removed from the stove; and when allowed to cool, the expansion of the pasteboard forms a substance almost inconceivably dense and hard. Nothing now remains but to turn the cylinder, and this is an operation of no slight labour and patience. The motion in turning must be slow, not exceeding about forty revolutions in a minute; and the substance is now so hard and tough, that tools of a very small size must be used to cut, or rather scrape it, until it is true. Three men are generally employed for the turning, even when the motion of the cylinder is effected by mechanical power, two being necessary to sharpen tools for the third who turns—so quickly are they blunted.

The upper and lower bowls 1 and 5 are generally of iron or wood, and of the same diameter as 2 and 4. For the common smoothing operation of the calender, it is only necessary that these five cylinders should be made to revolve on their respective axes, the motion of each being in an inverse direction to that of those with which it is in motion, and the revolutions must be in the inverse ratio of the diameters, that an equal portion of the circumference of each may be exposed to that with which it comes in contact. The motion is taken from the moving power by a belt passing over the pullies at D, that next the cylinder being fast upon the axis of the main cylinder 3, and the other loose upon the axis. Thus, when the belt is upon the fast pully, the calender will be in motion; and whenever it is shifted to the loose pully, the calender will stop without interrupting the motion of any other machine acted upon by the same power. The large cylinder 3 being set in motion, the iron cylinders 2 and 4 receive their motion by means of the wheels C, C, worked by the wheel B on the axis of the large cylinder. The cylinders 1 and 5 will revolve pretty accurately, merely by their friction upon the cylinders 2 and 4, or their motion may be rendered perfectly certain by other two wheels pitching into the wheels C, C. When a person stands in front of the calender, the cloth coming from behind, above the uppermost cylinder 1, passes between 1 and 2; passing behind 2, it again comes to the front between 2 and 3; between 3 and 4 it is again carried behind, and lastly brought in front between 4 and 5, where it is received, and smoothly folded on a clean board, or in a box, by a person placed there for the purpose. In folding the cloth at this time, care must be taken that it may be loosely done, so that no mark may appear until it be again folded in the precise length and form into which the piece is to be made up. The folding may be done either by two persons or by one, with the aid of two sharp polished spikes placed at a proper distance, to ascertain the length of the fold, and to make the whole equal. When folded into lengths, it is again folded across upon a smooth clean table, according to the shape intended, which varies according to the different kinds of goods, or of the particular market for which the goods are designed. In general, the obvious desire at every market is, to have the goods well smoothed and folded, so as to occupy the least possible bulk in packing. From this, however, a singular exception took place in a coarse kind of striped cotton stuffs, great quantities of which were carried out by the ships employed in the African slave trade. In that market, the estimation of a piece of those goods depended entirely upon its *bulk* when folded, and great care was therefore taken to have them done up very loosely, or what would in any other market have been termed *as ill dressed as possible.*

When the pieces have received the proper fold, the last operation previous to packing them, is the pressing. This is commonly performed by placing a certain number of pieces divided by thin smooth boards of wood in a common screw press, similar to those used by printers for taking out the impression left by the types in the printing press. Besides the wooden boards, a piece of glazed pasteboard is placed above and below every piece of cloth, that the outer folds may be as smooth and glossy as possible. The operation of the common screw press being found tedious and laborious, a very simple and efficacious method has been lately introduced of effecting the pressure by a column of water, which is so easy and expeditious, that the strength of a child is sufficient for the operation; and its power may be rendered much greater than what could be produced by almost any exertion of human force. These presses are used with great success in different extensive works; but as their discovery is recent, the application of the hydrostatical principle is also various. In Plate CVIII. Fig. 6, will be found a very simple mode of applying them to use, which it is hoped will sufficiently illustrate the general principle of their action, and may safely be adopted, with any judicious alteration which may render them more serviceable for the particular purpose in view. At present their novelty confines them to a few large works.

The water press may be made as to the frame work, very similar to any other kind of press; but it is to be observed, that as the pressure is upwards, it must be very strongly secured to the floor upon which it stands, and which must be equal to the whole mechanical reaction, or be sufficiently strong to resist the whole force of the pressure. In the Figure the frame work is distinguished by the letter A; the upper press board by G, and the under board by F. The board G is supposed to be fixed and immoveable in the two upright posts; but it would be very convenient that it should be made to slide up and down as required, and it may be stopped above by blocks of wood, or any of the means by which the sole of the common screw press is usually made up to the height wanted. It may also be counterpoised with weights, for ease in the management. The lower press board F, must slide freely up and down, like the upper board of the common press. Under this board is the receiver B, for the water, which is here supposed to be a hollow tube of leather, or any other soft substance which can be rendered impervious to water, and which must be sufficiently strong to resist a very great pressure. Let the leather tube therefore be stretched upon very strong hoops of iron, at two or three inches distance from each other, and again hooped without, immediately above those in the inside. The hoops within will then keep the tube always distended, and those without will counteract the lateral pressure of the water within. To the bottom of this receiver is attached a tube, branching from the main tube B, for admitting the water into the receiver, and C, C are two stop cocks in the main tube, the right hand one for admitting, and the left hand one for discharging the water. The pressure of the column of water in the main pipe D, will then be in the direct ratio of the square of its altitude, and the pipe, according to the pressure required, may be of any length. The goods to be pressed being placed between the press boards G and F, if the admitting cock be opened and the discharging cock shut, the under press board F will be forced up by the pressure of the whole weight of the column of water in the main pipe D; which, at 33 feet height, will give 15 ℔ pressure on every square inch. When the press is to be opened, it may be done in an instant by shutting the receiving and opening the discharging cock, which will discharge the water in the receiver into the drain at E. The simplicity of this press, and its immense power, render it one of the greatest improvements which have been lately applied to the practical purposes of manufacture, and where there is a command of water sufficiently elevated to fill the main pipe, it is wrought with no trouble or expence. Indeed, the waste of water is so very small, that the quantity may be easily collected from rain in a cistern, or may be sent up by means of a small forcing pump. A well bored iron cylinder, with a close filled piston, would be a safer and more durable receiver than the leather tube represented. But from the immense pressure, the piston would require much care in the packing.

For lawns and muslins of a light texture, the operation of smoothing requires a different process in some respects than close heavy fabric. They only require to be slightly smoothed, to remove any marks which they may have received at the bleaching; and as their beauty depends rather on their transparency than their closeness, the more the cylindrical form of the yarn is preserved the better. They are therefore put through a small machine, consisting of three rollers or cylinders; and as the power required to move this is small, the person who attends it generally drives it by a small winch. It is represented by Plate CVIII. Fig. 7. A being the frame, B the winch or handle, and the rollers 1, 2, and 3. The mid roller 2 is of smoothly turned iron, the other two of wood. It is always wrought cold. Bouk and mull muslins, which are finished with starch at the bleachfield to give them a clear wiry appearance, receive no other finishing at the calender than folding and pressing.

In the thick fabrics of cloth, including both those kinds which are used for many parts of household furniture, and those for female dress, the operation of glazing is used both to add to the original beauty of the cloth, and to render it more impervious to dust or smoke. The glazing operation is performed entirely by the friction of of any smooth substance upon the cloth; and to render the gloss brighter, a small quantity of bleached wax is previously rubbed over the surface. The operation of glazing by the common plan is very laborious, the apparatus being of the most simple kind. A representation of it is given in Plate CVIII. Figs. 2. and 3. A, is a table, with a thick stout cover of level and well-smoothed wood, forming an inclined plane; that side where the operator stands at work being the lowest, and is generally placed near a wall, as represented in the figure, both for convenience in suspending the glazing apparatus, and for the sake of light. A long piece of wood B, is suspended in a groove formed between two longitudinal beams D, D, placed parallel to the wall, and fixed to it. The groove resembles exactly the aperture between the sheers of a common turning lath. The lever B, of which the groove may be supposed to be the centre or fulcrum, is faced at the bottom with a semicylindrical piece of finely polished flint C, which gives the friction to the cloth stretched upon the table below. Above the flint are two cross handles at B, of which the operator lays hold, and moves them backward and forward with his hands, keeping the flint pressing slightly upon the cloth. When he has glazed a portion equal to the breadth of the flint C, he moves his lever between the sheers D D, and glazes a fresh part: thus he proceeds from one side or selvage of the cloth to the other, and when all which is upon the table is sufficiently glazed, he draws it over, and exposes a new portion to the same operation. To preserve the cloth at a proper tension, it may be wound smoothly upon a roller or beam, which being placed to revolve upon its own axis, behind the table another roller to receive the cloth may be placed before both, being secured by a catch, acting in a ratchet wheel. Fig 2. a profile, and Fig 3. a front elevation, will serve sufficiently to illustrate this description.

To save a great part of the labour employed in glazing cloth, the common five bowl calender has been recently altered to fit this purpose, and upon some years trial has succeeded to the satisfaction of those who use it. It is still confined to the extensive calender works of the late Mr Miller of Glasgow, and was the invention of the superintendant of his works. A profile view of this machine will be found in Plate CVIII. Fig. 5. It consists of five bowls or cylinders, like the common calender, but instead of those bowls revolving with a velocity in the inverse ratio of their respective diameters, so as always to present an equal surface, and to act merely by their pressure against each other; the bowls or cylinders 2 and 4 move with greater velocity than the bowls 1, 3, and 5, and thus create or generate friction at three several parts of the operation. This difference is produced merely by the addition of a few wheels; and the difference between the common and glazing calender will be seen at a single glance, by comparing the wheel-work of Figs. 4. and 5. In Fig. 4. the motions of all the cylinders is in the inverse ratio of their diameters, so that each presents an equal surface. In Fig. 5. the motion, instead of being directly communicated from 3 to 2, as in Fig. 4. is given by the intervention of two additional wheels. The increase of motion depending entirely on the relative number of the teeth in the wheels B and C, on the axis of the cylinders 3 and 2 to each other (for the intermediate wheels E and F merely communicate the motion without affecting the velocity), 3 is made to revolve considerably quicker than in the common calender, and thus the necessary friction is created. To reduce the glazing to the common calender, it is only necessary to remove the wheels E and F entirely, and to substitute a larger wheel for the wheel B, which may be calculated to work directly into the wheel C. The profile view given in this figure affords an opportunity also of shewing the way in which the cloth is conducted from the table H over the roller I, through the calender, and received again at G. This is common to both calenders. A patent for Scotland was taken for the glazing calender; and upon a trial of some years, it has met with the entire approbation of those who have been in habits of having their goods glazed by it. As one machine, by being worked day and night, is capable of glazing nearly 1000 pieces of cloth of 28 yards each in a week, it is peculiarly adapted for the occasional hurry to which shippers are sometimes unavoidably subjected.

As a matter of accommodation, the different processes of packing, cording of boxes, sheathing of trunks, and in general all the arrangements preparatory to shipments, and also the intimations and surveys necessary for obtaining drawbacks, debentures, or bounties, according to the excise laws, are generally conducted at the calenders where goods are finished, and these operations sufficiently account for the general meaning attached to the word. (J. D.)

CALENDULA, a genus of plants of the class Syngenesia, and order Polygamia Necessaria. See BOTANY, p. 302.

CALIBER COMPASSES. See COMPASSES.

CALICO, a species of plain cotton cloth, the knowledge of which is derived from the Indian manufacture, and the name from *Calicut*, the district in India where they are chiefly manufactured. The first attempts to manufacture calicoes in Britain, were made in Lancashire, about the year 1772, and that manufacture is now prosecuted there to immense extent, chiefly for the use of the printers. Calico is merely plain or alternate woven cotton cloth, of an intermediate thickness between those dense fabrics which are used for sheeting, and the more flimsy texture which is distinguished by the general appellation of muslin.

In the process of weaving, there is nothing curious to analyze; for it is so very easy, as to be among the first essays which an apprentice is required to make, in order to acquire some knowledge of the first principles of the art which he may be afterwards called to exercise in the most difficult and complicated of its numerous branches. As an article of general consumption, however, calico is an object of immense consideration to those manufacturers and merchants who produce and circulate printed goods for general consumption. Of all the cloths which are printed or stained by chemical and mechanical means, calicoes, from their cheapness, form by very far the largest proportion. Hence, if less objects of technical investigation, they are infinitely more so of mercantile and economical speculation. It is, therefore, to this particular branch of weaving, that the attempts (for hitherto they can be called little more) to weave by the application of mechanical power, have in almost every instance been directed: for what is technically termed shawl cloths, are merely calicoes of a different breadth and fineness.

The adaptation of yarn to *the reed* in the calico manufacture, may be very easily fixed; for, in general, there is but one universal standard, at least in Scotland. This is an 840 reed; or, as it is generally termed, an eight and two porter. Hence, in the Scottish phraseology, the term calico is seldom used; *blunk* is more common, but this properly signifies the application of cotton woof to linen warp. Among operative weavers, an *aught and twa* generally expresses the meaning without any addition. It may appear singular that 840 intervals of a reed should become an almost universal standard, whilst 850 forms the exact division by hundreds, which is the usual mode of counting; and its universal adoption forms a curious specimen of the means of economy fashionable at the time when it was adopted. The manufacture being then upon a much less extensive scale than it is now, and conducted with much less attention to regular method, the reeds were often constructed by porters of 20 splits each, and counted by them. But the regular manufacturers finding this practice (which subsisted chiefly among the customer weavers, as they were termed, who were employed to weave up home-spun yarn by industrious housewives) to be very inconvenient in extensive practice, and of little practical utility, abandoned it *in toto*, and contented themselves with dividing the hundred into two equal parts. Upon this division their scale of prices was regulated, rejecting all intermediate divisions. But as the manufacture of calico appeared likely to become extensive, and also to require the most scrupulous parsimony, by deducting ten splits from the fifty which formed the half hundred, they virtually reduced the price of weaving, while the difference neither violated their established usage, nor created discontent.

Cotton yarn, about No. 24 or 26 of the water or engine twist, is generally used for the warp, and they regulate the appearance of the cloth so as to appear either opener or denser in the fabric, by the fineness and quantity of woof which they use. As they wish to give every possible appearance of density to the fabric, the slack twined yarn spun by the common hand-jenny is used for this purpose.

In all the lighter kinds of cotton manufacture, in order to smooth any projecting fibres of the woof, it is generally woven in a wet state, which in some respects answers the same end as the mucilage used for dressing the warps; but in the calico, and most of the denser fabrics, it is woven perfectly dry, in order that it may appear as oozy as possible. (J. D.)

CALICUT, or more properly COLICODU, the name of a kingdom of India on the coast of Malabar, which now forms a part of the possessions of the East India Company. When Cheruman Permal resolved to end his days at Mecca, he divided the country of Malabar among his nobles; but having nothing left to bestow on the ancestor of the Tamuri, he gave that chief his sword, and all the territory in which the crowing of a cock could be heard from a small temple. This territory formed the original dominions of the Tamuri, and was called *Colicodu*, or the *cock crowing*. The country was possessed by the Tamuri Rajas till the Mussulman invasion. It was taken from Tippoo by the East India Company, in whose possession it still remains. A full account of the statistics and commerce of this part of India will be given under the article MALABAR, from very recent and authentic sources of information. See the following article. (*w*)

CALICUT, or CALICODU, the capital of the ancient kingdom of the same name, situated on the coast of Malabar. This town, which is chiefly inhabited by Moplays, is about three leagues in circumference, including an extensive suburb, principally inhabited by fishermen. Calicut consists partly of houses built of teak wood, or of bricks baked in the sun, and partly of huts composed of palm branches interwoven through each other, and covered with palm leaves, and beautiful gardens appear in every part of the town. The bazar was reckoned one of the finest in Malabar, and contained four or five fine streets. There are very few stone buildings, and the fortress is of much greater antiquity than the city. The natives suppose it to have been built by Cheruman Permal.

Mr Torin, the commercial resident at Calicut, has been endeavouring (December 26-30th, 1800) to establish a manufacture of the plain cotton goods called long cloths. It is of six callo fineness, or which is the same thing, its warp contains 744 threads, and the length of the pieces is 72 cubits, and their width 2¼. The price of each piece is, according to its quality, from 30, 32, to 34 gold fanams, or in our money 16*s.* 4½*d.* 17*s.* 5½*d.* 18*s.* 6½*d.* When this cloth is bleached, it is sent to Europe on the Company's account. In this manufacture no fewer than 237 looms are used. These employ 344 men, and produce monthly 468 pieces of cloth. The weavers, who are indolent and dishonest, were brought from the dominions of Travancore and Cochi. "Some men of the Panchala tribe," says Dr Francis Buchanan, "which here is called Peringullan, paint and varnish wood by the following process. They take butter-milk, and boil it with a small quantity of quick lime, until strings form in the accretion, and separate from the watery parts, which they decant. The stringy matter is then mixed with the paint, which has been well powdered. With these the wooden work is first painted; it is then allowed to dry for one day, and afterwards receives a coat of *pundum*, which is the fresh juice of a tree called *peini maram*. The pundum must be used while it is fresh, and will not keep for more than two or three days. After the first coat of pundum has dried, another coat of paint is given, and that is followed by another of varnish. In the same manner leather may be painted and varnished. The varnish effectually resists the action of water. All my attempts, however, to find out the varnish tree were vain.

Calicut and Vuypura form a small district; and unfortunately I have received no answers to the statistical queries which I proposed relative to it. From Mr Smee's valuable communications, I am persuaded, that, from the southern and middle divisions of Malabar, at least the following quantity of the produce of plantations is annually exported:

Cocoa nuts, 38,458, at 13½ rupees	519,048 Rupees.
Betel nuts, 58,392, at 3 fanams	32,916
Black pepper, 340 candies, at 125 rupees	62,500
Total rupees	614,464

Besides large quantities of ginger and turmeric; and I have already mentioned, that the quantity of black pepper is more than double that here stated."

Teak-wood, which was one of the principal articles of commerce at Calicut, has now become very scarce, in consequence of Tippoo having carried off all the elephants that were employed in this trade. The process of procuring this wood is very tedious. The tree which is intended to be cut down is first deprived of its branches; the trunk itself is then cut nearly two thirds through, and long incisions made in the bark. In this state it is left to dry for one year, during which the bark drops off. The tree is then pushed into the river Beypour by elephants, during the rains, and is floated down to within a little distance of Calicut.

The coast, which is low, and devoid of shelter, is accessible only by small flat-bottomed boats. A small cape or promontory projects into the sea; and though there is a good roadsted about three leagues from the shore, yet, when the wind blows from the sea, the shipping is exposed to considerable damage. The harbour is much less capacious than it was formerly, as a great part of it has been filled up with sand by the sea. The trade of Calicut is consequently in a languishing condition; but there is reason to hope that the Mahometan Arabs will take some means for removing the evil.

When the Arabs began to establish themselves in India, during the 8th century, Cheruman Permal, the sovereign of Malabar, not only embraced their religion, but resolved to end his days at the holy city of Mecca. Calicut, from which he departed, was thus endeared to the Moors; and, in spite of the inconvenience and danger of its port, it became the mart of their commerce. Precious stones, pearls, amber, ivory, porcelain, gold, silver, silk and cotton stuffs, indigo, sugars, spiceries, precious woods, aromatics, and fine varnish, were brought to Calicut from every part of the East, both in ships and by land-carriage on the backs of elephants.

When Vasco de Gama touched at the city of Melinda, he was astonished at the information he received respecting the commerce of Calicut; and, with the assistance of a skilful pilot, he stretched across the Indian ocean, and reached Calicut on the 22d of May 1498. Here he accidentally met with a Moor of Tunis, called Menzaide, who understood the Portuguese language, and who had admired the enterprising deeds of the Portuguese, which he had witnessed on the coast of Barbary. This Moor obtained an audience of the Samorin for Gama, who proposed an alliance and a treaty of commerce with the king of Portugal. Before the treaty was concluded, the Mussulmans succeeded in throwing suspicion on the views of Gama; and the Samorin dreading the effects which might result from such a connection, formed the resolution of cutting off Gama and his followers. The Samorin, however, had not the courage to execute his purpose; and he permitted the admiral to return to his ship. In consequence of making some reprisals, Gama compelled the Samorin to give him hostages, and to restore to him the merchandise which he had left in Calicut; and he returned to Portugal loaded with the rich spoils of the East.

Some time afterwards, thirteen Portuguese vessels, under the orders of Alvarez Cabral, arrived before Calicut, and brought back to the Samorin some of his subjects who had been carried off by Gama. These Indians spoke highly of the treatment they had received from the Portuguese, and induced the Samorin to treat them as friendly allies. The jealousy of the Moors, however, was again roused, and the people of Calicut, seduced by their schemes, massacred fifty of the Portuguese. Cabral, however, soon revenged their barbarous treatment He burned all the Arabian vessels that were in the harbour, battered the city, and repaired to Cochin and Cananore. The kings of these two cities gave him spices, gold, and silver, and proposed to enter into an alliance with him against the Samorin, to whom they were tributary. The kings of Oner and Coulan, and several other princes, joined in this proposal, with the hopes of freeing themselves from their tribute, and drawing to their harbours a portion of the commerce of Asia. Blinded by these views, the infatuated sovereigns of the East surrendered themselves, in a great measure, into the hands of the Portuguese. In every part of Malabar, the Portuguese obtained such influence, that they built a fort in every city, and compelled every sovereign to acknowledge himself a vassal of the court of Lisbon. The other nations of Europe, imitating the adventurous spirit of the Portuguese, sent out vessels to bring home the merchandise of the East; and such was the contempt and obscurity into which the Portuguese had fallen, that scarcely one of their ships was to be seen in the ports of the Samorin, where the English, Dutch, French, and Danes, had considerable factories. The Dutch established themselves here in 1604; the English followed them soon after; but the French did not establish their trade till about sixty years after the Dutch.

When Malabar fell into the hands of Tippoo, in 1789, he destroyed Calicut, and removed the inhabitants to Nelluru, the name of which he changed to Furruckabad. He razed the city to the ground, destroyed its trade, banished the merchants and factors of the foreign commercial houses. He cut down all the cocoa-nut and sandal trees, and ordered the pepper plants in the surrounding district to be torn up by the roots, and cut to pieces. His cruelty to the inhabitants of Calicut, was marked by the most dreadful barbarity. Great numbers of them, both male and female, were put to death. The mothers were first tied up, and then the children suspended from their necks. Several Christians and heathens, were brought out naked, and tied to the feet of elephants, which dragged them about, till they were torn limb from limb. All the churches and temples were burned or pulled down. Christian and Pagan women were compelled to marry Mahometans, and Mahometan women to marry heathens and Christians. The Pagans were deprived of the token of their nobility, which is a lock of hair named *cudumi*, and every Christian who was seen on the streets was either circumcised or hanged on the spot. About fifteen months after the inhabitants were removed to Furruckabad, the province was conquered by the English; and the inhabitants returned with transport to their old place of residence. Before the town was destroyed by Tippoo, it contained about six or seven thousand houses. It now contains about five thousand houses, and is rapidly recovering its importance. The inhabitants are principally Moplays, a stout and industrious, but villanous race of men, who settled in this country about 400 years ago, and are nearly as numerous as the Nairs, whose authority over them they dispute. East Long. 75° 52′, North Lat. 11° 12′. See *Nouvelle Relation d'un Voyage fait aux Indes Orientales contenant la Description des iles de Bourbon, et de Madagascar de Surate de la Cote de Malabar, de Calicut, &c.*, par M. Dellon. Amst. 1699. p. 178. This work was translated into English under the title of Dellon's *Voyage to the East Indies.* Lond. 1699; Bartolomeo's *Voyage to the East Indies*, Chap. vi. p. 139; Dalrymple's *Oriental Repository*, vol. i. p. 238, vol. ii. 165—168; and Dr Francis Buchanan's *Journey from Madras through the Countries of Mysore, Canara, and Malabar*, vol. ii. p. 474, and vol. iii. Appendix. (*o*)

CALIFORNIA, an extensive country in North America, reaching from Cape San Lucas on the South, to Cape Mendocino on the north, is washed by the Pacific Ocean, or Great South Sea on the west, and is separated from the continent by the Gulf of California, the river Colorado, and the Sierra Azul. It lies between 22½ and 40 degrees of N. Lat. and, according to M. Humboldt, its extent of surface is 9420 square leagues. This country is divided in the Spanish maps into old and new California, their boundary being the Bay of Todos los Santos, a little south from the port of San Diego. It has, however, been distinguished in various descriptions by different names. The northern part of it, or New California, received the name of New Albion, from Sir Francis Drake, who touched here in 1577; and Old California, so late as the middle of the 17th century, it being then supposed to be a large island surrounded with several small ones, was called Islas Carolinas, in honour of Charles II. of Spain, who had sent out a strong armament, to subjugate and take possession of the country. This expedition, however, having failed in its object, the name was soon dropt. It received its present name when first visited by Hernando de Grixalva, by the direction of Hernan Cortes in 1534; but the origin and etymology of this word has never been accurately ascertained. In all the various dialects of the natives, no trace of such a name has ever been discovered; and though some writers have had recourse to conjecture, and suppose that California is compounded of *calida* and *fornax*, a hot furnace, and was derived from the sultriness of its climate; yet we do not find that any of the Spanish captains ever took this method of giving names to their conquests. Father Venegas is rather inclined to think, that it owed its origin to some accident; possibly to some words spoken by the natives, and misunderstood by the Spaniards, as happened, according to a very learned American, in the naming of Peru. Be this as it may, it is distinguished among the inhabitants of the country by no general denomination, but is divided into a variety of tribes or hordes, each having a separate name and language peculiar to themselves. The Californians of the peninsula, according to Father Taraval, are divided into three distinct nations, whose languages bear no affinity to one another; the Pericues on the south, the Menquis in the centre, and the Cochimies on the north, each of whom are subdivided into several branches, distinguished by considerable variations in their dialect. In New California, the distinctions are still more numerous, and Father Lasuen has observed, that on an extent of 180 leagues from San Diego to the bay of San Francisco, no fewer than seventeen languages are spoken, which can hardly be considered as dialects of a small number of mother tongues. The nations of the Rumsen and Escelen, who form the population of the presidio and village of Monterey, speak totally different languages; while the languages of the different tribes of the Matalans, Salsen, and Quirotes, who live in the vicinity of San Francisco, are evidently derived from a common root.

The language of the Rumsen is proportioned to the feeble developement of their understandings. They have few words to express abstract ideas, or even to distinguish the several species of animals or vegetables. Their moral epithets are, in general, borrowed from the sense of taste, the gratification of which is their greatest delight; so *missich* signifies both a good man, and savoury food; and *keches* a wicked man, and tainted meat. The Escelen, however, have a richer idiom; and what is particularly curious, it has a greater resemblance to the languages of Europe than to those of America. The labials, of which the American languages are in general deficient, are used by the Escelen, particularly the letter F, which is pronounced by them in the same way as by Europeans. If we should be inclined to conclude from this, that the Escelen are strangers to this part of America, "it must at least be admitted," says La Perouse, "that they have been inhabitants of it for a long time past; for, in colour, features, and in general all the exterior forms, they differ nothing from the other people of this country." To shew the extreme difficulty of giving exact vocabularies of savage languages, and the impossibility of acquiring any adequate knowledge of them from the representation of travellers, we shall present to the curiosity of our readers, the numerical terms of the Rumsen and Escelen, as given by Humboldt and La Perouse.

ESCELEN.

	Humboldt.	*La Perouse.*
1	Pek.	Pek.
2	Ulhai.	Oulach.
3	Julep.	Oullef.
4	Jamajus.	Amnahon.
5	Pamajala.	Pemaca.
6	Pegualanai.	Pekoulana.
7	Julajualanai.	Houlakoalano.
8	Julepjualanai.	Koulefala.
9	Jamajusjualanai.	Kamakaialane.
10	Tomoila.	Tomoila.

RUMSEN.

	Humboldt.	*La Perouse.*
1	Enjala.	Moukala.
2	Ultis.	Outis.
3	Kappes.	Capes.
4	Ultitzim.	Outiti.
5	Haliizu.	Is.
6	Halishakem.	Etesake.
7	Kapkamaishakem.	Kaleis.
8	Ultumaishakem.	Oulousmasakhen.
9	Pakke.	Pak.
10	Tamchaigt.	Tonta.

It has been attempted by some travellers to establish a resemblance between the Mexican or Aztec language, and the idioms of the north-west coast of America; but they have completely failed. These languages differ in the most essential points; and even in their numerical words it is impossible to trace the smallest similarity. The Californians are totally unacquainted with the use of written characters. They have neither the symbols and hieroglyphics of the Mexicans, nor the letters of the most eastern nations of Asia; and by this means the origin of their nation is involved in equal obscurity with the origin of their language. If they ever possessed any invention to perpetuate their history, they have now entirely lost it. They are even destitute of every method of distinguishing the years, or the intervals of time, as the Mexicans did by means of their cycles of fifty years; and all that can be found among them, consists merely in some obscure oral traditions, probably more and more adulterated by a long succession of time. According to these traditions, their ancestors, being driven from their native settlements in the north, removed down to California, which they say was owing to a quarrel between two great men, who divided the nation into two opposite factions, and, after a bloody battle, the side which was defeated flew towards the south, and being eagerly pursued, was compelled to seek for safety among the mountains and islands of the sea. This is all the information which the Spanish missionaries have ever been able to procure concerning the origin of this people; and though the most probable conjecture is, that they, as well as all the other nations of America, have passed over from Asia since the dispersion of the nations, yet it must be admitted, that not one single monument has ever been discovered throughout the whole of the American continent, to authenticate clearly their Asiatic origin.

The Californians are of a more tanned and swarthy complexion than the other Indians of New Spain; but their faces are far from being disagreeable, and they are in general robust, vigorous, and of a healthy countenance. They seem, however, of all the American savages, to be nearest to a state of nature. "Their characteristics," says Father Venegas, "are stupidity and insensibility; want of knowledge and reflection; inconstancy, impetuosity, and blindness of appetite; an excessive sloth, and abhorrence of all labour and fatigue; an incessant love of pleasure and amusement of every kind, however trifling or brutal; pusillanimity and relaxity; and, in fine, a most wretched want of every thing which constitutes the real man, and renders him rational, inventive, tractable, and useful to himself and society; for even in the least frequented corners of the globe, there is not a nation so stupid, of such contracted ideas, and so weak in mind, as the unhappy Californians." Their utmost desire is to get the present day's food with as little fatigue as possible; and unless stimulated by hunger, they will remain whole days stretched out on the warm sand. Their life passes away in a perpetual languor and detestation of labour, except when roused to mix in the diversions of dancing or gaming, for which they seem to have a most inordinate passion. Some spirit of emulation, however, has been discovered among them; and they have sometimes been excited to exertion by seeing their companions praised and rewarded. But it is only upon such occasions that they can be prevailed upon to shake off their innate sloth. The quality which is chiefly valued among these savages is bravery, though they seem to be altogether ignorant of its true nature, and even destitute of mere animal courage. Their anger is excited by the slightest causes, but as easily appeased, and lasts no longer than while they meet with no resistance. They are daunted by the least opposition, and when once overcome with fear they will submit to the lowest indignities. But if, on the contrary, they have obtained any advantage, and their enemy appears disheartened, they will prosecute their malice, and exult over them with the most childish extravagance. It must be observed, however, that their rage is in general reserved for the enemies of their tribe. The greatest harmony prevails throughout the horde. Quarrels are scarcely known among them; and though they may be destitute of those nobler qualities for which some savage nations have been distinguished, they are also free from many of their vices. They are neither obstinate, harsh, nor cruel, but extremely docile and gentle, and easily persuaded to either good or evil. Inebriating liquors were unknown in the country; but they intoxicate themselves with the fumes of wild tobacco, which, however, is confined entirely to their festivals.

Among the Californians, every nation or language consists of several rancherias, more or less extensive, according to the fertility of the soil, and each rancheria of one or more families. They have no chiefs or caciques among them, whose authority they acknowledge either by tribute or external ceremonies. The Californian savage in all his actions is free and unrestrained.

He is entire master of his liberty, and knows no superior to whom he must give an account. Every family governs itself according to its own fancy; and the natural obedience of children to their parents, is forgotten as soon as the former are able to provide for themselves. On some occasions, however, they submitted to the direction of a leader, especially in gathering, at particular seasons, the fruit of the *pitahaya*, which constituted their principal food, in their fisheries, and in their military expeditions. But this dignity was obtained neither by blood, by age, by suffrages, nor by a formal election. He that was most brave, artful, or eloquent, assumed the command, and his authority was established by the tacit consent of his rancheria, who quietly submitted until the exigency was over which required his direction. In the time of war, this leader sent and received the messages to and from the adjacent friendly states; spirited his nation up to revenge; informed them of dangers, and headed them in battle. But their warlike expeditions were never undertaken, like many savage nations, for the sake of plunder, or to increase their territories, but generally to revenge some affront or injury among private persons, as the honour of the whole rancheria was supposed to be affected by an insult offered to any of its members. A more substantial, though not such a common cause of quarrel, was when one nation presumed to hunt, fish, or gather fruits, where another nation had acquired a prescriptive right. The offence was immediately followed by a declaration of war. Hostilities were commenced, and if the aggrieved party supposed themselves unable to give battle to their enemies, they applied for succour to some friendly rancheria. Preparations are then made as openly, and with as much noise and bustle as possible, in order to strike terror into their adversaries, and by this means obtain an easier victory. Every one was commanded to provide a sufficient quantity of arrows, which were made of reeds, curiously pointed with flint, but not poisoned; at least, if they used any substance for this purpose, it was very slow in its operations, for the Spaniards have never been able to discover such a custom, nor have met with any instances of slight wounds occasioned by these arrows proving fatal. They have also a kind of wooden spears, with the points sharpened and hardened in the fire, which they use when they come to close action, and which do equal execution with those pointed with steel. They advance to the attack with a loud shout, and engage without any regularity; and the battle is decided, not so much by conduct, strength, or courage, but by keeping up their spirits against their innate cowardice, and by shewing an apparent boldness, in order to inspire their enemy with fear. The Californians do not, like many American nations, eat their prisoners, or enemies killed in war, although, when they have slain a chief or leader of the enemy, they eat a small morsel of his body in the field of battle, being impressed with the idea, that it increases their courage. They burn their dead, and deposit the ashes in a *morai*; and, like the Canadians, they scalp the vanquished, and tear out their eyes, which they have the art of preserving from corruption. In some of their battles, immense numbers are slain on both sides; and many of the rancherias, in the south of the peninsula, have been totally destroyed by these intestine quarrels.

The ancient religion of this people, as far as can be collected from the accounts of the Jesuits, is a mixture of the most monstrous absurdities, of which it is impossible to give any adequate description. Indeed, these accounts vary so much, in many most essential particulars, that we are not disposed to place much reliance upon their accuracy. Father Venegas prefaces his account of the Californian religion, by telling us, that all relations agree, that idolatry was unknown in this country; that the inhabitants had neither creature nor image, to whom they paid any kind of adoration; nor any outward profession of religion, either in festivals, prayers, vows, expiations, or any public or private marks of addresses to God; and that they were involved in the same deplorable blindness as their neighbours, on the opposite coast of Cinalao, of whom Father Rivas says, that scarcely any trace of religion was to be found among them, nor did their external performances shew the least knowledge of God. But we are at the same time told, that they had among them a series of speculative tenets, resembling many of the Christian doctrines, though mixed with a thousand absurdities; an order of priests; and schools where their youth were instructed in religious opinions. That they had an idea of the true nature of God, of the eternal generation of the *logos*, of the doctrine of the Trinity, and of the fallen angels! which induced the missionaries to believe, that they must have been visited by some Christians, whose opinions they had imbibed, and had incorporated them with their own absurd notions. Each of the three nations, however, into which the Californian peninsula is divided, differs from the rest very materially in their religious ideas; and Father Venegas has furnished us with a very circumstantial account of these distinctions; but we have neither room nor inclination to follow his recital, and shall content ourselves with merely observing, that the Californians worship three divinities, who are supposed to carry on a war of extermination against each other: Sumongo, or the spirit of spirits, who lives in the north part of heaven, and punishes his people, by sending sickness and pestilence upon the earth: Niparaya, the creator of the world, who delights in peace; and Wac Tiparan, the evil spirit, who rebelled against Niparaya, and was cast down from heaven; each of whom have their particular worshippers.

The *edues* or priests, who are called *dicuinochos* by the Menquies, and those who inhabit the middle part of California, and *vamas* or *guasmas* by the Cochimies, pretend that they carry on a friendly intercourse with their deities; and are possessed of knowledge and power sufficient to prevent any calamity, or to give success to any enterprise. They have thus acquired such an absolute ascendency over the minds of this stupid and ignorant people, that they demanded as their right, the best of the fruits, and the choicest of the game, which had been procured either by fishing or hunting. If these were denied, or sparingly bestowed, they were threatened with sickness, disaster, and failure of harvests; but if given liberally, they were fed with magnificent hopes of affluence, and the most desirable enjoyments. But the authority of the Californian priests appeared most conspicuous at their public feasts, celebrated by a whole nation, or by a single rancheria or family. They then appeared in their habits of ceremony, which were only used upon extraordinary occasions, and which consisted of a large cloak, entirely composed of human hair, a high plume of hawk's feathers upon their head, and a monstrous fan of the same materials in their hand. Those of the Cochimies had, besides, a string of deer's hoofs round their neck, and another round their middle as a girdle. Thus accoutred, they opened the entertainment with sucking the *chacuaco*, till they became intoxicated, and almost frantic with the smoke; they then began an oration upon their tenets, which was delivered with the wildest gestures, and most frightful vociferations.

Upon such occasions they exercised the most wanton authority. According to their private passions, they celebrated some as brave and generous; and upbraided others as cowards, factious, and wicked, who were commanded to make expiation, by undergoing certain penances. Sometimes a single individual, sometimes a whole rancheria came under the sentence. In some cases, they were prohibited for a given time from tasting a certain fruit, fish, or beast; or enjoined to clear ways along the tops of the mountains, for the more easy descent of the visiting spirit, and to lay a heap of stones at certain distances, where it might stop and rest itself; and to such a length did they carry their influence, that they even sometimes ordered them to throw themselves from a precipice, and such was the blindness and dread of this people, that their orders were seldom disobeyed. The festival consisted chiefly in eating, drinking, dancing, talking, or laughing; and was considered as a religious solemnity, merely from the presence of the priests; and after being inflamed by gluttony and intemperance, the whole concluded with the most lascivious abominations. To these public feasts the neighbouring and friendly rancherias were usually invited, to whom they likewise sent challenges for wrestling, leaping, running, shooting with the bow, and trials of strength. They were sometimes held without any necessary motive; but, in general, they were made at the annual solemnity of boring the ears and nostrils of the children, for receiving the ornaments of pearls, which were common to both sexes; at the gathering of the pitahayas; for a victory; for the division of the capture of fish; and for distributing the deer skins to the women, which constituted their principal clothing. In some of the islands, however, particularly those on the western coast called De los Dolores, both the religion and customs of the inhabitants were very different from those of the peninsula. Every community had its civil and spiritual officer; and according to Father Torquemada, they had temples, images, altars, sacrifices, and sacred birds.

The Californians throughout the whole of the peninsula were uniformly destitute of any kind of clothing, and the only distinction among the natives in this respect was the form and nature of their ornaments. The Pericues braided their hair with strings of pearls, interwoven with small feathers. The Menquis wore a closely braided girdle round their waist, and on the forehead a curious fillet of net-work, made of *pita* thread; they also adorned their arms with bracelets made of *nacar*, a small round fruit like beads. The Cochimies, who usually kept their hair short, had a kind of diadem or crown formed of several bands of nacar, and sometimes of small white round snail shells, resembling pearls. Like several tribes of the Orinoco, these savages entertain a great horror for clothing. "A monkey dressed like an officer," says Father Venegas, "does not appear so ridiculous to us, as a man in clothes does to the Indians of California." They look upon it as effeminate and disgraceful. They were highly affronted when desired to cover themselves; and when offered clothes by the missionaries, they either refused them, or afterwards threw them away. The women, however, paid more attention to decency, and even the infants of the female sex were not without a proper covering. Some had garments manufactured from the leaves of a certain species of palm tree, which, being beat, assumes the appearance of rough flaxen threads, but which, instead of being woven, were merely fastened to one another at the top, and hung down in very close and thick skeins and tufts. Of these they formed a petticoat, which reached to the feet; and also a short cloak which they threw over their shoulders. Others formed their petticoats of thin pieces of sedge fastened together with *mescal* threads, and covered their bodies with skins of deer, sea wolves, hares, foxes, and other beasts. They all bedaubed their faces with ointment, and painted their skin by way of ornament.

The Californians being a wandering people, removing from place to place in quest of subsistence, their habitations were suited to their mode of life. They cost them very little trouble in the construction; and, when overrun with vermin, as was sometimes the case, they set fire to them, and then rebuilt them in an hour or two. Some of them were composed of a few stakes fixed in the ground, which were drawn together at the top, and covered with bark or sedge; the entrance was low and narrow; the fire was placed in the centre, and the smoke escaped through a hole in the top. They lay down on skins spread round the fire, and slept indiscriminately, without distinction of age or sex. Others consisted merely of a little space inclosed with stones heaped upon one another, half a yard high, without any covering but the heavens, and so constructed that they had not room to stretch themselves at full length. The whole of their furniture consisted of a bow and arrows, a wooden spear, a bowl made in the shape of a high crowned hat, a *batea* or jug, a bone which served them for an awl, a little piece of touchwood for kindling a fire, and pita nets for fishing, for gathering fruits, and for carrying their children. These nets shewed very great skill, and were made of so many different colours, and such exquisite workmanship, that Father Taraval affirms, "of all the nets I ever saw in Europe and New Spain, none were comparable to these, either in whiteness, the mixture of the other colours, or the strength and workmanship, in which they represent a vast variety of figures." This furniture was carried by the women when they removed from one place to another; the men had only their warlike weapons, with their appurtenances, as flints and feathers for their arrows, and strings for their bows.

Polygamy, though admitted and practised among the Californians, was not general, but appeared to be confined chiefly to the southern districts. Among some of the nations their marriages were negociated by the bridegroom presenting the bride with a batea or jug made of mescal thread; her acceptance denoted her consent, which she communicated by returning a net for the head. Among others, the agreement was concluded at the end of a feast, given by the lover to the whole rancheria. Their marriages, however, lasted only during the pleasure of the parties, and were annulled by the slightest motive. They attached very little importance to the exclusive possession of their women, as they often staked their favours as prizes at their games; and so weak is natural affection among this people, that mothers have been known frequently to destroy their children in any scarcity of food.

The disorders to which the Californians were subject, arose chiefly from intemperance in their pleasures, and the vicissitudes of the climate. In winter, they were exposed to sore throats, pleurisies, and catarrhal affections; and to putrid, bilious, and inflammatory fevers in the summer. They were also liable to dysentery, ophthalmia, and to itch, and other cutaneous affections. But, though their diseases were both numerous and various, the method of cure was nearly the same in all: which consisted in the use of a few plants, fumes of wild tobacco, cold bathing, and stoving, or the warm air-bath. Their only physicians were the priests, who endeavoured to inspire confidence in their remedies, by a pretended intercourse with invisible spirits; and their cures were always administered with great ostentation and solemnity. The most remarkable was the application of the *chacuaco*, a tube formed out of a hard black stone. This tube being filled with *cimarron*, or wild tobacco, and applied to the affected part, the smoke was either sucked in, or blown down, according to the physician's direction. "This powerful caustic," says Venegas, "sometimes without any other remedy, has been known entirely to remove the disorder." But, when all remedies proved ineffectual, when herbs, juices, baths, and the chacuaco had been tried in vain, the patient's relations were assembled around him, that he might die in their presence; and if he had a daughter or sister, the physician cut off the little finger of her right hand, pretending that the blood would either save the patient, or at least remove from the family all sorrow for his death. He was no sooner supposed dead, than they immediately proceeded to bury or burn him, with all his utensils, which was done amidst the continued outcries and howlings of the spectators.

In this account of the manners and religion of the Californians, we have confined ourselves entirely to their savage state, before the knowledge of Christianity was introduced among them by the Jesuists, and their country annexed to the Spanish dominions in America. The independent tribes still retain the same habitations, the same dresses, and the same amusements; but since the establishment of the Spanish missions in California, their savage manners have been greatly softened, many of their religious ceremonies abolished, and civilization and agriculture have rapidly increased. In these missions, the colour and industry of the Indians, the house of the monks, the magazines built of bricks, the threshing floor, the cattle, the horses, all present the appearance of a plantation in any of the West India colonies. But, before we proceed to a description of their present state, we deem it proper to give a brief account of the discovery of the country, and of its establishment by the Spaniards.

We have already observed, that California was first discovered in 1534, by Hernando de Grixalva, in a voyage undertaken by the order, and at the particular expense of the famous Hernan Cortez, who had fitted out several small squadrons for the purpose of prosecuting his discoveries in the South Sea. Discontented with the tediousness and unsuccessfulness of these discoveries, Cortez embarked in person, in 1536, with 400 Spaniards and 300 negro slaves, and landed in the eastern coast of California, in the bay of Santa Cruz, now called the Port de la Paz. Having coasted both sides of the gulf, with great difficulty and danger, he returned to Santa Cruz, with the loss of many of his companions, who had died of famine and fatigue. Urgent affairs, however, demanding his presence in Mexico, he committed the command of the squadron to Francisco de Ulloa, who, in the course of two years, ascertained the coasts of the gulf of California, then known by the name of the Sea of Cortez, to near the mouth of the Rio Colorado. But the first European settlement which was attempted in this peninsula, was by order of Philip II, of Spain, in 1596, who appointed Sebastian Viscaino to the command of an expedition fitted out for that purpose. The Spaniards landed in the Bay de la Paz, and, finding the Indians of a peaceable and friendly disposition, established a garrison within a pallisade; and erected a small church and some huts with branches of trees, as the capital of their conquest. The natives brought them fruit, fish, and also some pearls; but this friendly intercourse did not long continue, for they were irritated and provoked by the excesses and outrages committed by the Spanish soldiers, who, both here and in other parts of the coast which they went to visit, had drawn upon them the hatred of the inhabitants. Being distressed for want of provisions, and soon perceiving that the soil was unable to produce sufficient food for such a number of men, General Viscaino determined to abandon the conquest, without leaving any settlers in the country, and returned to New Spain at the end of the same year. About six years after, Viscaino was again appointed to explore the north-west coast of California, in order, if possible, to discover some convenient harbour that might afford an asylum to the galleons on their return from Manilla. In this expedition, which was attended with much danger and distress, he fell in with a very commodious and spacious harbour in 32 degrees of north latitude, which he called San Diego; and also another in 36° 40′, which he named Monterey, and which has since become the principal settlement of the Spaniards in this country. He describes the country as covered with trees, the climate mild, the soil fruitful and well peopled, and the natives kind and tractable. From that time California was frequently visited by private adventurers, for the sake of the pearls which were found upon its coast, which they either fished, or purchased from the Indians; and it is to the rapacity of these persons, and the many acts of cruelty and injustice which they committed against this people, that we are in a great measure to attribute the failure of the many expeditions which were afterwards undertaken for the reduction and colonizing of this country. Spain, being at last tired of making such fruitless attempts, and irritated at the loss and expense which had been occasioned by these expeditions, had entirely renounced the conquest of California, when the Jesuits, in 1697, requested permission to undertake the conversion of its inhabitants. Father Salva Tierra entered upon this enterprize with only six soldiers and three Indians; and having landed in the bay of San Dionysio, on the 19th of October, founded the presidio of Loretto, which is now the principal place of all the missions of Old California. They were at first received with great joy and affection by the Indians of the neighbouring rancherias, to whom they distributed a daily allowance of *pozoli*, or boiled maize, in order to induce them to attend to the religious exercises and instructions of the holy father. But what was given as a favour was soon claimed as a right; and the Californians, pleased with the maize, demanded a larger allowance than usual, which being refused, they broke out into complaints, which in a short time ended in open hostilities. They surrounded the Spanish garrison and threatened them with destruction. They twice attempted to carry of their cattle, and even stole the only horse belonging to the mission. But, by the determined courage and perseverance of the Spaniards, they were reduced to submission, and treated with the same kindness and attention. The father continued his instructions, and the maize was served out as formerly. The inconstancy and ingratitude of this people, however, was such, that it was found impossible to bind them, either by promises or affection; and it was not without much difficulty, and after submitting to many hardships and deprivations, that they had the prospect of rendering this colony a permanent establishment. They had not only to struggle against the inclemencies of the climate, and the hostility of the inhabitants, but also against the calumnies and opposition of their own countrymen. Succours had frequently been promised, but as often withheld; and Father Salva Tierra, saw himself, at one time, on the point of abandoning for ever the conversion of the Californians, from the impossibility of procuring a sufficient subsistence for the missionaries, and others employed in the enterprise. Their zeal, however, at last surmounted every opposition, and in a few years several missions and presidios were founded throughout the peninsula. Whatever were the motives by which these men were actuated, whether by a love of power, or a serious regard for the propagation and interest of religion, we cannot deny them the merit of exploring this neglected province, of civilizing its rude benighted inhabitants, and of bringing many of them to the knowledge of Christianity. Though their labours have not succeeded, either according to their zeal or their expectations, yet the cause of the failure did not lie with them, but with the nature and situation of the country. The peninsula of California is barren and unwholesome, while the neighbouring provinces of Sonora and Cinaloa, on the eastern side of the gulf, present to the Spaniards abundant mines and a fertile soil, objects more precious in their eyes than the precarious wealth arising from the fishery of pearls, which is the only attraction of Old California. It is owing to this circumstance, that both the spiritual and temporal progress of these missions have been very slow. This country can boast of only one Spanish colony; and "4000 Indians," says La Perouse, "converted and collected together in its fifteen parishes, are the sole fruit of the long apostleship of the different religious orders which have succeeded each other in this painful ministry." Loretto is the only presidency of Old California. Its garrison consists of 54 troopers, who furnish small detachments to its fifteen dependent missions, which are San Vincente, San Domingo, El Rosario, San Fernandez, San Francesco de Borgia, San Gertrude, San Ignacio, La Guadalupe, Santa Rosalia, La Conception, San Josef, San Francesco Xavier, Loretto, San Josef de Cabo Lucar, and Todos los Santos. The population of this peninsula, however, within the last forty years, has been rapidly diminishing. Some of the parishes are almost destitute of inhabitants, especially St Ignacio and Guadalupe; and this diminution has been attributed to the smallpox, and another malady too common among Europeans, and which they have invariably introduced into all their settlements in the new world. Another cause, however, may be found in the many obstacles to improvement, which arise from the nature of their political institutions.

But while the Spaniards, for nearly a century and a half, were wasting their strength and treasure in attempting to convert and civilize a barren and ungrateful country, it is a matter of surprize that New California, whose shores had been carefully examined by Viscaino, and represented by him as both populous and fertile, should have been so long neglected. This fine country, which would have most amply repaid all their exertions, if properly colonized, was not occupied by the Spaniards until 167 years after its first discovery; and it was not until the court of Spain was alarmed at the progress of discovery made by other maritime powers on the north-west coast of America, and dreaded lest she should be anticipated in forming settlements in that quarter, that orders were given to the Chevalier de Croix, the viceroy, and the Visitador Galvez, to found missions and presidios in the ports of San Diego and Monterey. The expedition by sea anchored at San Diego, in April 1769; but owing to the scarcity of provisions, their fatigues, the want of shelter, and an epidemical disease, the consequence of the bad quality of their food, the colony was reduced to great distress. Most of them fell sick, and only eight individuals remained on their feet, when the land expedition, which had come through Old California, arrived with assistance. But it was not till after a whole year of researches and labour, that they succeeded in finding again the harbour of Monterey, although Viscaino had clearly pointed out its situation and latitude. The first mission was established at this place, in 1770, by the Franciscans, who still remain possessors of the missions of this province, although, since the expulsion of the Jesuits, the duties of the missions in the peninsula are performed by Dominican friars. The missions of New California, with their population, and time of establishment, are shewn in the following Table:

Names.	Founded.	Population in 1802.
1. San Diego, - - -	1769	1560
2. San Carlos de Monterey, -	1770	700
3. San Antonio de Padua, -	1771	1050
4. San Gabriel, - - -	1771	1050
5. San Luis Obispo, - -	1772	700
6. San Francisco, - - -	1776	820
7. San Juan Capistrano, -	1776	1000
8. Santa Clara, - - -	1777	1300
9. San Buenaventura, - -	1782	950
10. Santa Barbara, - -	1786	1100
11. La Purissima Concepcion, -	1787	1000
12. Soledad, - - -	1791	570
13. Santa Cruz, - - -	1794	440
14. San Jose, - - -	1797	630
15. San Miguel, - - -	1797	600
16. San Fernando, - - -	1797	600
17. San Juan Bantista, - -	1797	960
18. San Luis Rey de Francia, -	1798	600

According to M. Humboldt, the population of New California, including the Indians attached to the soil, and who have begun to cultivate their fields, was doubled in twelve years. In 1790, there were 7748 souls, and in 1802 they had increased to 15,630. Since the foundation of the missions, there were in all, according to the parish registers, 33,717 baptisms, 8009 marriages, and 16,984 deaths. These registers, however, must not be assumed as data from which we may deduce the proportion of births and deaths, as in the number of baptisms the adult Indians are confounded with the children. The number of Whites, Mestizoes, and Mulattoes, may be fully estimated at 1300, upon whom alone the government can depend for the defence of the coast, in case of any military attack by an European power. The smallness of this number, so disproportionate to the fertility and extent of the country, is owing entirely to the absurd regulations by which the Spanish presidios are governed, and the principles of colonization followed by Spain, which are in general directly opposite to the true interests, both of the mother country and colonies. "It is truly distressing," says the Spanish navigator Galiano, "that the military, who pass a painful and laborious life, cannot in their old age settle in the country, and employ themselves in agriculture. The prohibition of building houses in the neighbourhood of the presidio is contrary to all the dictates of sound policy. If the whites were permitted to employ themselves in the cultivation of the soil, and the rearing of cattle, and if the military, by establishing their wives and children in cottages, could prepare an asylum against the indigence to which they are too frequently exposed in their old age, New California would soon become a flourishing colony, and resting place of the greatest utility for the Spanish navigators, who trade between Peru, Mexico, and the Philippine islands."

The governor of the Californias resides at Monterey, with a salary of 4000 piastres. His authority is confined entirely to the garrisons and the independent Indians; for he is not allowed to interfere with the affairs of the different missions, but is only obliged to grant assistance when they claim it. His real subjects consist only of four hundred military, distributed in the different presidios, which are all the means that are required for keeping in subjection about 50,000 wandering Indians. Every parish is governed by two missionaries, whose authority over the converted Indians is absolute; and the domestic economy of each mission differs scarcely in any respects from the regulations of a West India plantation. "The men and women," says La Perouse, "are assembled by the sound of a bell; one of the priests conducts them to their work, to church, and to all their other exercise. We mention it with pain, the resemblance is so perfect, that we saw men and women loaded with irons, others in the stocks, and at length the noise of the strokes of a whip struck our ears, this punishment being also admitted, but not exercised with much severity." The utmost regularity and order pervades these religious communities. Seven hours a day are allotted to labour, and two to prayers; they have each a certain allowance of food, which consists of boiled corn and maize, and which is prepared and served out in the morning, at noon, and in the evening. On festivals, the ration is beef, which many of them eat raw. Corporal punishments are inflicted on both sexes, for the neglect of pious exercises, or for the smallest dishonesty; that of the women, however, is private, while the men are exposed to the view of all their fellow converts, that their punishment may serve as an example. As soon as an Indian is baptised, he immediately becomes a member of the community, and subject to its laws. On no pretence whatever is he allowed to return to his rancheria or family; his fate is as decided as if he had pronounced eternal vows, and should he escape, he is brought back by force, and under pain of the lash is compelled to join in the solemn devotions of the altar, and to offer up his unwilling prayers to that Being, who desires not the homage of the lips, but the free and unreserved worship of the heart. This system of government has been attempted to be justified from the character and disposition of its subjects. They are represented as a nation of children that never arrive at manhood: they are small and weak, entirely destitute of that love of liberty and independence which characterises the northern nations, and equally ignorant of their industry and arts. They have very few ideas, are almost incapable of reasoning, and have so little stability, that unless continually treated as children, they would escape from those who have been at the trouble of instructing them, and again return to their original barbarism. But if the Californian Indian be so destitute of the ideas and qualities of men as he is represented, by the present principles of Spanish legislation he will be continually kept so. He has no property that he can call his own. His labour and actions are entirely under the direction of his masters, whom he has been taught to regard as superior beings, who hold an immediate and constant intercourse with God; and thus he is retained in that very species of ignorance, which it should be their chief study to eradicate. "Would it be impossible," says La Perouse, "for an ardent zeal, and an extraordinary patience, to convince a small number of families of the advantages of a society founded on the rights of the people? to establish a right of property among them, which is so bewitching to all men; and thus, by this new order of things, to engage each man to cultivate his field with emulation, or to dedicate his time to some other kind of employment." It must be allowed, however, that though the executive power of the missionaries is absolute and uncontrouled, the Indian converts throughout this country are governed with the greatest mildness and humanity.

We shall now proceed to give a general description of this province, with a short account of its various productions. In such an extent of country, it cannot be expected that the temperature of the air should be uniform. Accordingly we find in California a very great variety of climate. In the northern province the sky is often foggy, and very cold winds sometimes blow with impetuosity from the north and north west; but the climate, in general, is much more mild than in any similar situation of the same latitude on the eastern coast of America. In the central districts of the peninsula the air is excessively dry and sultry; but in the southern parts it is more moderate, and of a more kindly quality, the heat being tempered by its proximity to the ocean; and towards the northern extremity of the gulf, in the same seasons of the year, the water even freezes. The sky is constantly serene, of a deep blue colour, and without a cloud; and it has been frequently observed, that should any clouds appear for a moment at the setting of the sun, they display the most beautiful shades of violet, purple, and green; a phenomenon which is supposed to depend upon a particular state of the vesicular vapour, and the purity of the air.

Old California is in general barren, wild, and rugged, and overrun with rocks and sand. A chain of mountains stretches along the interior, of which the most elevated, the Cerro de la Giganta, is from 4500 to 5000 feet above the level of the sea, and appears to be of volcanic origin. They are almost totally bare of verdure, or at most only covered with small shrubs, briars, and low trees. Among these mountains, however, are interspersed several vallies of a tolerable soil; and some of the plains, particularly in the vicinity of the coast, are well adapted both for pasture and tillage, and might be greatly improved by cultivation. Its greatest deficiency is the scarcity of water. From Cape San Lucas to the river Colorado, an extent of nearly 200 leagues, there are only two streams that run into the Gulf of Califorma; the one passes through the mission of San Josef, and discharges itself into the bay of S. Barnabas; the other is the Mulege, which waters the mission of Santa Rosalia. The currents which descend on the eastern side of the mountains, are far from being numerous; but their course and position have not yet been distinctly ascertained. Several springs are scattered throughout the country, whose waters, except in times of great rain, are swallowed up in the arid sand long before they reach the ocean.—"Through a particular fatality," says M. Humboldt, "it is remarked, that the rock is naked where the water gushes out, while there is no water where the rock is covered with vegetable earth. Wherever springs and earth happen to be together, the fertility of the soil is immense; and it was in these places, of which the number is far from great, that the Jesuits established their first missions." New California, however, has a very different appearance. It is well watered, woody, and fertile; and is one of the most picturesque countries in the world. Frequent fogs and dews give vigour and vegetation to the soil, which consists of a black spongy earth, and produces in great abundance many of the first necessaries of life. Wheat, maize, barley, beans, lentiles, &c. are cultivated in the fields; and most of the roots and fruit-trees of Spain have been carefully introduced into the gardens of the Indians. They have, besides, plantains, bananas, cocoa-nuts, sugar-canes, indigo, and a great variety of small herbs and plants. One species of these plants, called *pita*, supplies the Indians with thread for making their nets, and other purposes; and of others they make a kind of plates and baskets, of a very elegant and intricate workmanship. Of the same herbs, the inhabitants on the banks of the Colorado form little tubs, called *coritas*, which generally hold about two bushels of maize, and with which they transport their goods from one shore to another, without being the least damaged by the water, by swimming and pushing them before them. Wild vines grow in the interior of the country, and yield very large grapes, but of a very sour quality; and European vines and olives have been cultivated here with great success. Good wine is made in all the villages along the coast as far as the 37th degree of north latitude; and near San Diego, oil is made of as excellent a quality as any in Andalusia. But the principal and most useful of all the indigenous trees of California, is the *pitahaya*, a kind of beech, the fruit of which formerly constituted the great harvest of the poor inhabitants. It is chiefly found in a dry soil, and differs in appearance from all other trees. It has no leaves, and the fruit grows to the boughs, which are fluted, and rise vertically from the stem, forming a very beautiful top. The fruit is like a horse chesnut, and full of prickles; but the pulp resembles that of a fig, only more soft and luscious, but always of an exquisite taste. The most valuable quality of this fruit, however, is its being a specific against the distemper *de Loanda*.

This country abounds with domestic animals, and fish and game of every description. Hares and rabbits are very common, and the trees are inhabited by the most delightful birds. The thickets are stocked with small grey tufted partridges, which are extremely well flavoured, and feed in large companies of three or four hundred. On the ponds and sea-shore are wild ducks, grey and white pelicans, gulls, cormorants, curlews, ringplovers, small sea water hens, and herons. The forests are filled with stags of a gigantic size. Flocks of forty and fifty of them are frequently seen browsing at a time. They are of a brown colour, with large branches nearly 4½ feet long, and are considered as among the most beautiful animals in Spanish America. These stags, which are not found in Old California, surprised Sebastian Viscaino, when he visited this country in 1602. He asserts that he saw some whose branches were nearly nine feet in length. They are amazingly fleet, and can scarcely be taken, except by artifice, which is practised with great success by the Indians of this country. They fix a stag's head, with its long branches, upon their own, and, armed with a bow and arrows, they creep on all fours, and by half concealing themselves among the brushwood and long grass, and imitating the motion of a stag when feeding, they draw around them the unsuspecting herd, who become the victims of the deception. This method of hunting was seen by La Perouse, in the savannas in the neighbourhood of Monterey; and the Indian played his part so well, that some of the French hunters would have fired at him, had they not been prevented. The skins of these animals, when dressed by the inhabitants, might be converted into a very considerable branch of commerce. A more profitable article, however, is the otter skins, of which there are here a prodigious number. Until 1786, the Spaniards never suspected that these skins were of any value, and never thought of sending them to Europe; but the government, being informed that a trade in this valuable peltry would be productive of the greatest advantages, have reserved the exclusive commerce of them to itself; and it is supposed that the number of otter-skins, if properly collected in New California, would annually amount to nearly 30,000. The Indians who inhabit the missions are sometimes employed in spinning coarse woollen stuffs, called *frisadas*, and also a kind of cotton, which they extract from the rind of certain fruits. But the principal employment of the converted Californians is agriculture; and the cultivation of this country has increased with great rapidity within these last twenty years. In 1791, the black cattle throughout the whole of this intendancy amounted to 24,958, which in 1802 were increased to 67,782, besides 107,172 sheep, 1040 hogs, 2187 horses, and 879 mules. During the same period, the cultivation of grain was more than doubled. In 1791, according to the tables of M. Galiano, the Indians sowed only 874 *fanegas* of wheat, which yielded a harvest of 15,197 *fanegas*; while, in 1802, 2089 fanegas were sown, and the produce 33,576 fanegas. "This progress of agriculture," says M. Humboldt, "this peaceful conquest of industry, is so much the more interesting, as the natives of this coast, very different from those of Nootka and Norfolk bay, were only thirty years ago a wandering tribe, subsisting on fishing and hunting, and cultivating no sort of vegetables." So much, however, cannot be said for the peninsula of Old California. The few fertile spots produce sufficiently luxuriant crops of maize, wheat, French beans, garvanzo, or a kind of pease, and all sorts of esculents; and the vines which have been cultivated here, yield excellent grapes, the wine of which resembles that of the Canary Islands. But the arid nature of the soil, and the want of water and vegetable earth in the interior, must always prevent this country from maintaining a numerous population. The aridity of the soil, however, is in some degree compensated by the immense quantities of fish, and almost every species of pearl oysters, which are found upon its coast; and these last have been the chief inducement to adventurers during two centuries for visiting this desert country. These oysters are most abundant in the southern part of the peninsula, particularly in the bay of Ceralvo, and round the islands of Santa Cruz and San Josef. They lie in great numbers on banks in the gulf, which are commonly called *hostias*, in three or four fathoms water; and may be seen as plain as if they were on the surface. The pearls are very beautiful and large, but frequently of an irregular figure. This fishing has been a source of great wealth to the Spanish colonists; and indeed since the cessation of the pearl fishery near the island of Marguerite, the gulfs of California and Panama are the only places in Spanish America which supply pearls for the commerce of Europe. This branch of commerce has of late years very much fallen off, owing to the avarice and violence of the adventurers, who pay the Indians and negroes employed as drivers so poorly, and treat them so harshly, that the fishery is considered as almost abandoned. The cordillera of Old California is inhabited by animals which resemble, both in their form and their habits, the *mouflon* of Sardinia. Their horns are curved in a spiral form; and they leap, like the ibex, with their head downward; but are essentially different from the wild goats, which are of an ashy white, and peculiar to New California.

"New California," says La Perouse, who visited the country in 1786, "notwithstanding its fertility, cannot as yet reckon a single settler; some soldiers married to Indian women, who dwell in forts, or who are spread among the small detachments of troops in the different missions, at this time constitute the whole Spanish nation in this part of America. If it were at a less distance from Europe, it would in no respect yield to Virginia, which is opposite to it; but its proximity to Asia may indemnify it, and I am of opinion, that good laws, and more especially liberty of commerce, would speedily procure it some settlers; for the Spanish possessions are so extensive, that it is impossible to imagine that, for a long time to come, the population can become numerous in any of its colonies. The great number of both sexes who are in a state of celibacy, and have taken vows to continue so, and the invariable policy of the Spanish government to admit only one religion, and to employ the most violent means in support of it, will incessantly oppose a new impediment to every increase." See Venegas' *History of California*: Humboldt's *Political Essay on the Kingdom of New Spain*, vol. ii. p. 319; and La Perouse's *Voyage*, vol. ii. p. 194. (*h*)

CALIGULA, Caius Cæsar, the fourth of the Roman emperors, was the son of Germanicus, the adopted son of Tiberius. He was born on the 31st day of August, in the year of Rome 765, and the twelfth of our æra. Being brought up from his infancy in the camp, his mother Agrippina, an able intriguing woman, wishing to make him popular, always dressed him in the habit of a common soldier, or caligatus, so termed from wearing the caliga, or military boot; from which circumstance, Caius was affectionately distinguished among the men by the name of Caligula, or the little private. Soon after the death of his lamented father, whom he had accompanied in the expedition to Syria, Caligula returned home, and lived with his mother, who, in a short time, incurring the suspicions of Tiberius, was banished by the senate. He then removed to the house of Livia Augusta, at whose funeral obsequies he pronounced an oration, though yet but a stripling; and having resided for some time with his grandmother Antonia, he was summoned, in the twentieth year of his age, when he assumed the *toga virilis*, to attend his grandfather Tiberius to Capræa.

Tiberius seems at first to have had a favourable opinion of the talents of his grandson, as his principal motive in bringing him forward at this time, was to counterbalance the influence of Sejanus, now an object of jealousy to the tyrant. Caligula did every thing in his power to recommend himself to the emperor. Not a word escaped his lips respecting the condemnation of his mother, and his two brothers; his fierce feelings he so carefully suppressed in the presence of Tiberius, that no insult or provocation could rouse him; and he so effectually studied and assumed the conduct, humours, language, and even tone of voice of the emperor, that it was soon remarked of him, that "never was there a better servant, nor a worse master." His natural disposition, however, which was ferocious and base beyond conception, occasionally broke out in spite of all his dissimulation. It was even then observed, that he eagerly attended at all executions and tortures; muffled up in a long garment, he prowled through the streets at night, and engaged in the lowest debaucheries; whilst proficiency in dancing, fencing, singing, and other accomplishments of the same nature, constituted the sole object of his ambition. So sensible was Tiberius himself of the depravity of his character, that he often asserted, that Caius lived but to be the destruction of him and all around him, and confessed, that he was rearing a serpent for the Roman people, and a second Phaeton for the world.

About this period, Caligula was married to Junia Claudilla, or Claudia, daughter of Marcus Silanus, a most respectable senator; but Junia soon afterwards dying in childbed, he attached himself to Ennia, the wife of Macro the pretorian prefect. This woman he won over to his purposes, under a solemn promise of marrying her on his accession; an event which, according to some, she and her husband materially contributed to accelerate, having, by the directions of Caligula, poisoned the emperor. The real intention of Tiberius with regard to the succession is not well ascertained. Well aware of the monstrous character of Caligula, he seems to have wished his rejection; but the memory of Germanicus, and the popularity of Caligula himself with the army, deterred him from any open attempt to exclude him. He therefore bequeathed the empire conjointly to him and his brother Tiberius Gemellus, a young lad of considerable promise. No sooner, however, was the breath out of the emperor, than the senate, instigated by a blind hatred of the old tyrant, immediately cancelled the will, and appointed Caligula their sole master. This melancholy event took place A. D. 37.

The real character of Caligula being hitherto but little understood among the people, his accession was hailed with universal joy. During even the funeral procession of Tiberius, amid the victims, altars, glaring torches, and other customary demonstrations of woe, the giddy multitude, observing this hopeful favourite in his mourning attire, could not contain their raptures, but greeted him with their blessings and acclamations; and, in three months after his accession, 160,000 victims are said to have been offered throughout the empire in thanksgiving to the gods. On one occasion when he was indisposed, the people of Rome watched all night round the palace; many of them, in conformity to the superstition of the times, engaged to fight in single combat for his recovery; and some even devoted themselves to death, by a label which they displayed, as substitutes to Pluto for the life of the emperor.

The first acts of Caligula were by no means ill calculated to encourage this universal attachment. Besides shewing a proper regard for the ashes of his mother and brother, who had fallen sacrifices to the jealousy of Tiberius, he pretended to burn all the documents which might lead him to a knowledge of those implicated in their condemnation. When a memorial was presented to him respecting a design on his life, his reply was, "that he was conscious of no action for which he could be hated, and that he was determined to shut his ears against all informers." His conduct in other respects was equally flattering. Among other popular actions, he banished from the city all the infamous professors of vice, restored valuable privileges to the people, strengthened the authority of the magistrates, was extremely nice as to the qualifications and conduct of the knights, remitted taxes, conferred donations, relieved distress, and, in short, was much too good an emperor to continue so. For all these reasons, a golden shield, among other honours, was decreed to him, which was every year to be borne in solemn procession to the capitol, by a company of priests, followed by the whole senate; while the children of the prime nobility, boys and girls, were all to chaunt in regular cadence the praises of this mighty benefactor.

The Roman people were destined soon to awake from this delusive dream. Whether we are to ascribe his conduct to insanity, to the corruption of the times, or to the genius of despotic authority, one thing is certain, that Caligula disgraced the character of human nature more than any other individual. There is something in unlimited power, well calculated to nurse and bring to perfection the caprices of human nature; and to this circumstance we are probably, in a great measure, to ascribe the whimsical beneficence and the wanton barbarities of this and the other tyrants who then governed the world. Subjected to no controul or responsibility by a political constitution, furnished with no motives of fear or ulterior ambition, either in this world or in the next, they were naturally impelled, like the inferior creatures, by every motion of the animal fluids, and pardoned, butchered, and oppressed, without any other reason than the humour of the moment. Absolute princes are always mad in proportion as they are powerful; once above the consideration of law and public opinion, we are prepared for every inconsistency, and every enormity.

One of the first public crimes of Caligula, was to put to death Gemellus, the unfortunate youth already mentioned. Silanus, too, his father-in-law, Macro and his wife Ennia, and several others, all of them zealous agents in promoting his accession, were rewarded for their services with death. Many were the persons of all ranks who fell victims either to his political jealousy or to his caprice. An exile, who had been banished by Tiberius, having returned, and being asked by Caligula how he had spent his time, the man, by way of flattery, told him "that his constant occupation was praying to the gods that Tiberius might be destroyed, and Caligula advanced in his room:" upon this, thinking that those exiled by himself would in like manner wish for his destruction, Caligula sent his executioners through all the islands, to put the whole of them to death. His innate love of cruelty exceeds belief. He never allowed the executioner to finish criminals by one great blow; but ordered him to proceed by minute and frequent strokes, that they might feel themselves dying. The slightest offence, such as omitting to swear by himself, often provoked him to extremities. It was one luxury of his to compel fathers to witness the execution of their sons, and, on one occasion, when an apology was sent, he invited the wretched man to a magnificent banquet, and assuming all the ease and gaiety of which he was capable, entertained him with the utmost merriment and jocularity. Caligula was frequently heard to lament, that his times were not distinguished by some signal calamity. Sensible that his tyrannical conduct made him an object of universal detestation, his common maxim was, *oderint dum metuant*, "let them hate me, provided they fear me;" and once, when the people hissed in disapprobation of his pursuits, his rage burst out in the horrible wish, that the Roman people had but one neck, which he might cut off at a blow.

The monster sometimes attempted wit in the midst of his butcheries. Some Gauls and Greeks having been condemned together, probably for the sake of the execrable pun, he boasted that he had done for Gallogræcia. A military gentleman having gone for his health to Greece, and petitioned from time to time for a renewal of his leave of absence, the tyrant at last ordered him to be slain, adding, that as medicine had been of no service to him, blood-letting was absolutely necessary. Even in his most pleasant moods, this tremendous jester thought of nothing but blood. When kissing the neck of his wife or mistress, he frequently remarked, "pretty as this neck is, off it goes the moment I order it." One day at a sumptuous banquet, he suddenly burst out into laughter, upon which the two consuls, who reclined by him, politely ventured to demand the cause of his imperial merriment. "I was only thinking," replied Caligula, "how easily, by a single nod, I could assassinate both of you." His jest with Apelles the tragedian was more serious, whom he ordered to be flogged most unmercifully, that he might hear, in their native excellence, the fine tones and inflexions of voice of that actor.

It would be disgusting to enumerate the various acts of oppression, by taxation, pillage, torture, and murder, recorded of this wretch, who was also equally infamous for his effeminacy and horrible debaucheries. His incestuous passion for his own sisters is well known. His sister Drusilla, with whom he had been detected in scandalous familiarities when a boy, he now actually married; and he bewailed her death with the most extravagant frenzy of grief. His next madness was, like Alexander the Great, to give himself out for a god. He actually built a temple to his own divinity, and instituted a priesthood, altars, and sacrifices, in honour of himself; and sometimes exhibited himself among a crowd of statues of his brother gods, being consulted by the people, and giving responses. As a deity of equal rank, he used to invoke the full moon to his embraces at night. He likewise held private conferences with Jupiter Capitolinus, at one time muttering something in a low voice, at another, gravely listening; and was not unfrequently heard to remonstrate with the other god in pretty sharp language. All this folly was scarcely more extravagant than his fondness for his horse Incitatus. In honour of this animal, he built a magnificent palace, appointed domestics, and supported a splendid table, to which people were invited in the name of the horse. He moreover accommodated the steed himself with a marble stable, and an ivory rack, gave him gilt barley, and wine out of a golden cup, swore by his health and fortune, and, according to some, intended to make him consul.

In his public transactions, Caligula was equally extravagant and cruel. He engaged in immense undertakings, such as filling up vallies, and levelling mountains, merely because they were deemed impossible. Among these, his famous bridge at Baiæ was none of the least. This bridge, supported on two rows of boats, consisted of large beams of timber, over which was placed a bank of earth, faced and paved with solid masonry, so as to resemble the Appian way; and extended over the sea from Baiæ to Puteoli, being a distance of near four miles. Along this floating structure, Caligula paraded on horseback and in chariots for two successive days; and to add variety to the scene, having invited a great number of people to view the bridge, he tossed them all into the sea, and there knocked them on the head with oars and poles to keep them under water. Wishing now to appear in the character of a conqueror, he ordered an expedition to be prepared with the utmost haste, resolving to conduct it in person into the heart of Germany. His march through Gaul was sometimes so rapid, that the standard-bearers could not keep pace with the troops; on other occasions it was so extremely slow, that he waited to have the roads swept and sprinkled with water by the inhabitants of the country. When in the act of crossing the Rhine, some person unluckily expressed his uneasiness lest the Germans might now be at hand; upon which Caligula was so frightened, that he suddenly turned back, and would not wait till the bridge was cleared, but was handed over the heads of the soldiers to the other side of the river. Soon after, in order to retrieve his character, having commanded some German deserters to be stationed privately in a wood, and a report to be suddenly spread in the camp that the enemy was near, he put himself courageously at the head of his guards, and assuming the air of a great hero, sallied out in quest of the foe, scoured the forest, and then ordered a great number of trees to be converted into bare trunks, on which to erect the trophies of his victory. On his return from this glorious campaign, he nearly ruined Gaul with enormous exactions, in order to defray the expences of another expedition against the ocean, which he had determined to conquer. For this purpose, having drawn up his legions on the beach, arranged his battering rams and other military engines, and ordered the trumpets to sound preparatory to the charge, he suddenly commanded the soldiers to stoop down and fill their helmets with shells, which he called the spoils of the ocean. In commemoration of this victory, he built a lofty tower on the spot, on which a light was kept burning for the direction of mariners. The next care of the conqueror, after announcing, by letters, all these exploits to the senate, was to make arrangements for his triumph, which he resolved should be very magnificent. Great numbers of Gauls, the tallest that could be found, were engaged for moving in the character of German captives in the procession. These were compelled to dye their hair of a red colour, to assume various uncouth dresses, and to pronounce occasionally some hard words, resembling German and other savage languages.

These childish follies were succeeded by a design of a more serious nature. Recollecting that some legions had once mutinied against his father, Caligula resolved, like a strict disciplinarian, now to decimate them. With this view, he summoned them to appear before him without their arms, while his cavalry was observed ready to surround them; but the legions suspecting some treachery, put themselves in a posture of defence; upon which the tyrant fled to Rome, to wreak his vengeance on the worthless senate.

The public patience began now to be nearly exhausted; plots and conspiracies began to be talked of, and a formidable combination, headed by Lentulus Getulicus and Marcus Lepidus, were actually discovered. Many were the deaths which this conspiracy occasioned. Caligula now kept regular lists of those intended for destruction, and seems to have meditated the horrible design of cutting off the whole senate, with a great proportion of the principal knights. His odious career, however, was now drawing to a close. Cassius Chærea, a brave officer, but unfortunate in having a very effeminate voice, being ridiculed on this account by Caligula. and exposed by his indecent jests to the derision of others, resolved to rid the world of the monster; and many other Romans, exasperated in like manner by insult and oppression, joined him in the project. After a variety of disappointments and narrow escapes, the conspirators at last found an opportunity of executing their design, amid the confusion of a festival. While the emperor was passing from the theatre to the palace, during the celebration of the games in honour of Augustus, Chærea gave him a wound in the neck, and the other conspirators rushing upon him at once, dispatched him by repeated blows, none offering to assist him. His carcase was allowed to remain on the spot where it fell till night, when either his wife or Agrippa employed some person to remove it, and committed it half burnt to the earth. Not content with his own death, the conspirators resolved to exterminate his whole family, and accordingly one of their party, that very night, put to death his wife Cæsonia, and his infant daughter, who is said to have already manifested the ferocious disposition of her father.

Thus perished, A. D. 41, in the 29th year of his age, after a reign of three years and ten months, one of the most odious tyrants that ever afflicted the human race. No sooner were the tidings of his death sufficiently confirmed, than the people gave loose reins to their indignation. His statues were instantly pulled down, his capricious laws annulled, and his memory as much as possible obliterated. The external appearance of Caligula was no bad emblem of his mind,—his form, features, complexion, and gestures, all conspiring to produce a sensation of disgust and horror. His countenance, which was naturally repulsive, was, in this respect, improved by art, for we are told that he practised at his mirror all the frowns and distortions of face which he deemed best calculated to inspire terror. He was not deficient either in talents or education; and would have made no contemptible figure as an orator; but his chief attention was directed to the acquisition of fame as a dancer, musician, gladiator, and charioteer. Caprice and cruelty, those constant attributes of tyranny, were the most prominent features of his disposition, and, combined with sensuality and cowardice, formed nearly the whole of his character.

As Seneca justly observes, Caligula seems to have been produced by nature for the purpose of shewing what mischief could be accomplished by the greatest depravity, supported by the greatest power. See *Suetonius. Universal History. Crevier.* (E)

CALIPH, or KHALIF, the title by which the successors of Mahomet were distinguished. As the history of the caliphs has already been given in its proper place, (see ARABIA,) all we propose at present is to give a short sketch of their general character, and of the nature of the office with which they were invested.

The immediate successors of the founder of a new religion, and a new empire, widely extended, but not yet fully confirmed, found themselves under the necessity of imitating the qualities, by which he had succeeded in establishing his character as a prophet, and his power as a sovereign. An affectation of enthusiastic devotion, and of rigid austerity, was essential to the impostor, who pretended an immediate commission from heaven. The piety of Mahomet was habitual and ardent; his pretended intercourse with the Almighty, frequent and ostentatious; and, except in one species of indulgence, which he granted liberally to the faithful, and which formed the most attractive allurement of his paradise, his temperance and sobriety were singular and exemplary. In these qualities he seemed even to be surpassed by the enthusiasm, the austerity, and the abstinence of the first caliphs. All the time which they could spare from the duties of royalty, was spent in prayer or in preaching, before the sepulchre of the prophet. Abubeker, on being elected to the caliphate, ordered his daughter Ayesha to take a strict account of his private patrimony, that it might be easily ascertained by his subjects, how far he was enriched or impoverished by his exalted office. He claimed, as his just reward for the service of the state, an annual salary of three pieces of gold, with the maintenance of a single camel, and a black slave; but on the Friday of each week he distributed the remainder of his private fortune, and the public treasure, amongst the most worthy and the most indigent of the Moslems; a coarse garment, and five pieces of gold, were all the riches he had to bequeath to his successor. The mortifications and the humility of Omar were still more rigid, or more ostentatious than those of Abubeker. Barley bread, or dates, were his only food; water was his drink; his gown was torn in twelve places; and a Persian satrap, who came to do him homage, found him asleep among beggars on the steps of the mosque of Medina.

An usurper, who, without any peculiar advantages of wealth or family, proposes to raise himself to absolute power, must secure the affections and the confidence of his countrymen, by profuse liberality, insinuating affability, and humble condescension. The pretended apostle of God, satisfied with the power of royalty, affected to disdain its pomp; submitted even to the menial offices of the family; kindled the fire; milked the ewes; and mended with his own hands his shoes and his garments. His faithful adherents were rewarded by munificent presents; the wavering were confirmed by splendid promises; and all his countrymen were gratified by the gracious smile of the prophet, who imposed on them the yoke of spiritual and temporal bondage. These popular qualifications were cultivated with no less attention and effect by the earliest of his successors. Multitudes were fed by the bounty of Abubeker, the mildness and condescension of whose general demeanour conciliated every heart. The manners of Omar were equally modest and unassuming; and his bounty, like his treasures, was still more ample than that of his amiable predecessor. To Abbas, the uncle of the prophet, he assigned an allowance of twenty-five thousand pieces of silver; to each of the aged warriors, who survived the battle of Beder, he allotted five thousand pieces; and rewarded with an annual pension of three thousand, the last and meanest of the followers of Mahomet.

To found a new dynasty among a people so enterprising and warlike as the Arabs, required the dazzling accomplishments of a hero, as well as the sanctity of a prophet, and the prudence and sagacity of a statesman. The splendid victories of Mahomet were continually adding credibility to his pretensions as the messenger of God, commissioned to propagate the true religion, by persuasion or by the sword; to convert or to exterminate the unbelieving nations throughout the world. His successors gloried in the distinction of being commanders of the faithful. The warlike virtues of Abubeker, Omar, and Othman, had been displayed under the banners of the prophet; and the hope of dominion, or of paradise, made them ready to encounter every peril in the propagation of the faith. Omar, in his reign of ten years, reduced thirty-six thousand cities, or strong holds, to his obedience; demolished four thousand churches or temples of the infidels; and erected fourteen hundred mosques for the exercise of the Mahometan worship. In one hundred years after the flight of Mahomet from Mecca, the empire of his successors extended from India to the Atlantic ocean, comprehending the widely distant regions of Persia, Syria, Egypt, Africa, and Spain.

When the power of the caliphs was confirmed beyond the fear of revolution, they forgot the real or affected virtues, which their predecessors had found necessary to its acquisition. Their interest, indeed, prevented any abatement of their zeal for the extension of Islamism: but the moderation, the affability, the self-denial, even the courage by which the first caliphs were distinguished, soon gave way to the love of pomp, of oppression, of luxury, and effeminacy, naturally inspired by uncontrouled dominion over countless myriads, and by the exhaustless resources of the richest portions of the globe. The cares of government were relinquished for the softening pleasures of the seraglio; the rewards by which merit ought to have been encouraged, were appropriated by women and favourites; and even when a caliph took the field against an enemy, his camp was encumbered by the unwieldy luxury of the palace. The enervating influence of this example spread rapidly through the empire. The warlike ardour of the Saracens was quenched by their love of ease, and of debasing indulgence; and no promises or rewards could allure to the field the descendants of those enthusiastic champions, who had voluntarily crowded to the standards of Abubeker and Omar. After a duration of 656 years, the power of the caliphs was abolished by the Tartars, who captured the holy city of Bagdad, A. D. 1258, and put to death Al Mostasem Billah, the last of the race of Abassides.

As the caliphs succeeded to the regal and sacerdotal offices which Mahomet had assumed, they were the most absolute monarchs in the world. No privileged order was recognized in the Arabian empire, to impose a salutary restraint on the will of the despot; and among a people, enslaved by superstition, and ignorant even of the name of liberty, no feelings of independence ever arose to prompt resistance to the tyranny of the vicar of the prophet, the vicegerent of God. The Koran was, indeed, prescribed as the rule of their actions, and inculcated strongly the duties of justice and humanity; but they were themselves the judges and interpreters of that sacred code, nor was the most zealous Moslem at liberty to dispute their infallibility. In quality of iman, or high priest of the Mussulman religion, the caliph began the public prayers every Friday in the chief mosque, and delivered the *khothbah*, or sermon, animating his hearers to zeal and fidelity in their duties as true believers. The first part of this service was always performed by the caliphs in person, even when they affected the most pompous state, or were sunk in the most luxurious indulgence; but the utterance of the sermon was committed, in later times, to a deputy or assistant. It was part of the duty of the caliphs to conduct the pilgrims to Mecca, and to march at the head of the armies of his empire; and it was their prerogative to grant letters patent of investiture, as well as swords, standards, robes, and other insignia to the Mahometan princes, who, even after they had thrown off the yoke of the caliphate, continued to hold of it as vassals. The caliphs usually went to the mosques mounted on mules; and the sultans Selgiucides, although masters of Bagdad, were compelled to hold their stirrups, and to lead their mules for some distance on foot; until they received from the caliph the sign of permission to mount on horseback. In short, the office of the caliphs, uniting spiritual influence with temporal power, bore a striking resemblance to that of the pope; and in their pomp, their haughtiness, and their oppression, little difference can be traced between the vicars of Mahomet, and the successors of Peter. See Herbelot's *Bibliotheque Orientale;* Ockley's *History of the Saracens;* Sale's *Koran;* Gibbon's *History*, vol. ix. x.; and *Mod. Univ. Hist.* vols. i. ii. iii. (*k*)

CALIPPIC PERIOD. See CHRONOLOGY.

CALY YUG. See CHRONOLOGY.

CALLA, a genus of plants of the class Heptandria, and order Monogynia. Linnæus ranks this genus under Gynandria Polyandria; Schreber under Monœcia Monandria; and Dr Smith under Monœcia Polyandria. See BOTANY, p. 102.

CALLAH EL, from *Calah*, the top, is the name of a town in the western province of Algiers, and appears to be the Gitlui or Apfar of Ptolemy, from the number of large rivers. It is situated on an eminence on a range of mountains, which forms a part of Mount Atlas. Though larger than Mascar, from which it is distant about five leagues north east, it is dirty and irregular, and has neither pavements, causeways, nor drains. "There are several villages of the same nature, says Dr Shaw, and in the like situation, round about it; all of them profitably employed in the same manufacture of carpets and burnooses."* The Turks have a small garrison and citadel in this place See Shaw's *Travels in Barbary*, vol. i. chap. ix. p. 71. Edinb. Edit. (*w*)

CALLANDER, a town of Scotland, in the county of Perth, is situated on the banks of the river Teith, a very considerable stream which issues from Loch Katrine, and discharges itself into the Forth. Callander is built on both sides of the river, but principally on the northern side, and the river is crossed by a good stone bridge. It consists chiefly of one long street: the houses are well built, and covered with slate. In a square space, on the northern side of the street, and in the middle of the village, stands the parish church, which has a pavilion roof, and a spire over the pediment. Near the minister's house is the foundation of an old square castle, built or repaired in 1596, by Livingstone, Earl of Linlithgow. Since the introduction of the cotton manufactures, the town has been greatly extended. About 100 looms are employed in weaving muslin in Callander, and in the adjacent village of Kilmahog, and nearly 100 girls are occupied in the tambour manufacture. Since Loch Katrine became such a fashionable place of resort, Callander has been much frequented during the summer season, and a large and commodious inn has been built for the accommodation of travellers. Population of the village about 1000. See PERTHSHIRE. (*o*)

CALLAO, a sea-port town of Peru, situated on the west coast of South America, at the embouchure of the river Lima, and about 2½ leagues from the city of Lima. Prior to the earthquake which happened in 1746, the Spaniards regarded this town as impregnable. It was defended by a garrison, and was fortified with bastions and batteries. Two of the suburbs were then inhabited by the Indians.

The harbour of Callao has always been regarded as the largest and most secure in the South Sea. There are no rocks in the bay, and the water is very deep. As the winds which prevail here during the winter always blow between the south east and the south, but most generally from the south, the bay of Callao is always tranquil, being defended from the south winds by a long neck of land which projects into the sea, and by the large island of St Lawrence opposite to this cape, and the small islands of Fronton and El Corcobado. The river of Lima, which discharges itself into the sea under the walls of Callao, furnishes abundance of good water, and the loading and unloading of vessels is facilitated by a mole furnished with excellent cranes.

On the 20th of October 1687, at the second concussion of the earthquake, the sea retired within its usual limits, and returning in mountainous waves, overwhelmed Callao and the adjacent country. During the earthquake of 1746, this town suffered still greater devastations. The port of Callao and several of the buildings sunk into the ground; but this evil was nothing, compared to the dreadful catastrophe which succeeded it. "The sea, says Ulloa, receding to a considerable distance from the shore, returned in mountainous waves, foaming with the violence of the agitation, and suddenly turned Callao and the neighbouring country into a sea. This was not, however, totally performed by the first swell of the waves, for the sea retiring further, returned with still more impetuosity, the stupendous water covering both the walls and other buildings of the place, so that whatever had escaped the first, was now totally overwhelmed by these terrible mountains of waves, and nothing remained except a piece of the wall of the port of Santa Cruz, as a memorial of this terrible devastation. There were then 23 ships and vessels, great and small, in the harbour, of which 19 were absolutely sunk, and the other four, amongst which was a frigate called St Fermus, carried by the force of the waves to a great distance up the country. This terrible inundation extended to other parts on the coast, as Cavallos and Guanape. At Callao, where the number of inhabitants amounted to about 4000, two hundred only escaped; and twenty-two of these by means of the above-mentioned fragment of a wall."

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* The burnoose answers to our cloak. It is generally wove in one piece, and is strait about the neck, having a cape for a cover to the head.

The town of Callao has been rebuilt upon the same place, at the distance of a quarter of a league from the sea, and has been called Bella-vista. As Callao is the sea-port of Lima, a full account of its trade will be given under the article LIMA. West Long. 76° 58′, South Lat. 12° 1′ 53″. See Juan and Ulloa's *Voyage to South America*, vol. ii. book vii. chap. viii. p. 82-84, in which will be found a plan of the port of Callao.

CALLAO, or according to Europeans, CAMPELLO, a small island in the Chinese sea, stretching in a north westerly direction, along the coast of Cochinchina, about 30 miles from the continent, and is nearly five miles long and two broad. Its eastern shore is rendered completely inaccessible by a continued range of overhanging cliffs and immense rocks, which in some places rise perpendicularly out of the sea; while the opposite side of the island is covered with verdure, and indented with several small sandy bays, affording safe and convenient stations for landing. These, however, are separated from each other by steep and rugged ridges, which renders all communication between them by land extremely difficult.

At the bottom of one of the largest of these bays, is a fertile valley, containing about two hundred acres, where the ground rises gently towards the east, and is bounded on each side with lofty mountains, the highest of which is about 1500 feet above the level of the sea. "This small but enchanting spot," says Mr Barrow, "is beautifully diversified with neat houses, temples, clumps of trees, small hillocks swelling from the plain, and richly decorated with shrubbery and trees of various kinds; among which the elegant *areca*, rising like a Corinthian column, is eminently conspicuous." This is the only inhabited part of the island; and the principal village, which stands upon the margin of the beach, contains about 30 habitations. A few of the houses are built of stone and roofed with tiles, but the rest are constructed entirely of bamboo, and have a very neat and cleanly appearance. About 30 others are scattered over the valley, behind each of which are enclosures of sugar canes, tobacco, and other vegetables; at the head of the village is a house larger than any of the rest, which Mr Barrow supposed to be the habitation of the chief person of the island. It was divided into a number of apartments, and enclosed by a stone wall; and the approach to it was through a gateway between two stone pillars. On the side of the hill behind the village, is a cave, accessible only by one path, through an irregular range of rocks; and at its mouth is a small temple, which commands a view of the whole plain. This temple is open in front, with a colonnade before it of round wooden pillars, painted red and varnished. Several others of the same construction are dispersed up and down the valley. The inhabitants rear a few goats on the sides of the mountains, which are covered with luxuriant pasture; and they water their rice fields by carrying a small rivulet along the upper ridges of the vale, and conveying it through sluices, as occasion requires, to the grounds below.

When Mr Barrow visited this place, the principal inhabitants, terrified at the approach of a strange vessel, embarked in their gallies and left the island; and as none of the people whom he met with could understand his Chinese interpreter, he was obliged to have recourse to hieroglyphics, and to draw the figures of such articles as he wished to purchase. Poultry and fruits were immediately brought, for which he paid high prices, in order to conciliate the good will of the islanders. See Barrow's *Voyage to Cochinchina*; or, Staunton's *Account of an Embassy to China*, vol. i. p. 366, &c. (L)

CALLE, LA, a seaport town of Algiers, in the province of Constantine. The sea surrounds it on three sides, and the other side is defended by a strong wall. About the year 1560, a company of merchants from Marseilles built a fort near this place for the protection of their magazine of corn, and of the boats in which they carried on the coral fishery. The Algerines speedily demolished this fort, under the pretence that the French had carried off so much corn as to occasion a famine in the country, but, in 1728 Louis XIII. sent an engineer to build another fort called the Bastion of France, at a little distance to the east of the former ones. The foundations were scarcely laid, when the Moors and Arabs again destroyed it, and compelled the engineer to re-embark. The French king, however, unwilling to abandon his plan, completed the fort a few years afterwards, and the French African Company established themselves in the place. The insalubrity of the situation, arising from the ponds and marshes which are adjacent to it, induced the company to enter into an agreement with the Dey of Algiers, by which they were permitted to remove to La Calle, another inlet about three leagues to the east, and to carry on a free commerce with the Moors and Arabs. At La Calle, they had a magnificent house and garden, three hundred coral fishers, a company of soldiers, several pieces of ordnance, and a place of arms. The rest of the town consists of mean huts, inhabited by the lower orders from Marseilles, who were employed in the service of the company. "Besides the advantages of the coral fishery," says Dr Shaw, "and of the whole trade of the circumjacent country, they have also at Bona, Tuckush, Sgigata, and Cull, the monopoly of corn, wool, hides, and wax; from which they pay yearly to the government of Algiers, to the Kaide of Bona, and to the chiefs of the neighbouring Arabs, 3[illegible],000 dollars, i. e. about 5000 guineas of our money—a trifling sum for such great privileges." Dr Shaw thinks that the Bastion and La Calle are too near each other to be taken for the Diana and Nalpotes of the Itinerary, though he is of opinion that they ought to be looked for in that situation. Population about 400. West Long. 8° 50′, North Lat. 36° 50′. See Shaw's *Travels in Barbary*, vol. i. p. 111. Edin. edit. chap. vii. (*o*)

CALLEN, a port town of Ireland, in the county of Kilkenny and province of Leinster. The principal objects deserving of notice in this place, are the ruins of an abbey, and three castles, with some traces of walls which Cromwell is said to have destroyed, and a moat about 40 feet high, with a flat top 138 feet by 72. About 3660 acres of fine ground, with a limestone bottom, are included within the liberties of the town, and a common of 1500 acres, which has been greatly diminished by encroachments, belong to the inhabitants. There is here a distillery, and some lace is manufactured in the towns. The seven fairs which are held at Callen, are remarkable for the sale of horses and turkeys. Great quantities of the latter are bought up for the purpose of being sent to Bristol. Number of houses 582. Population 3500. West Long. 7° 34′. North Lat. 52° 32′ (*w*)

CALLICARPA, a genus of plants of the class

Tetrandria, and order Monogynia. See Botany, p. 113.

CALLICOCCA. See Cephaeles, and Botany, p. 144.

CALLIGONUM, a genus of plants of the class Dodecandria, and order Tetragynia. See Botany, p. 220.

CALLIMACHUS, a celebrated Greek poet and grammarian, was born at Cyrene, in Lybia, flourished at Alexandria in the reigns of Ptolemy Philadelphus, and Ptolemy Euergetes, and died about the year 244 B. C. He was the son or descendant of Batus; whence he is called by Ovid *Battiades*. (*Am.* i. 14. 33. *Tr.* ii. 367. &c.) He studied under Hermocrates, the grammarian; and, before he attracted the notice of Ptolemy Philadelphus, taught a school at Alexandria, and had the honour of educating Apollonius, author of the *Argonautics*.

The poetical compositions of Callimachus consisted chiefly of short pieces, such as hymns, elegies, and epigrams; and when it was remarked to him, that his powers seemed to be unequal to the production of any considerable work, he is said to have made use of the proverbial answer, "A great book is a great evil." He was the author, however, of two works of greater length, entitled *Hecate* and *Aitia*.

Quinctilian gives to Callimachus the first place among the elegiac poets of Greece. (*Inst. Orat.* x. 1.) Those of his compositions which have been preserved are admired for their elegance and classical spirit. The following, we believe, are the principal editions of his works. *H. Stephen's*, 4to, 1577; *Mad. Dacier's*, 4to, Paris, 1674; *Graevius's*, 8vo, Utrecht, 1697; *Bentley's*, 8vo. London, 1741; *Ernesti's*, 8vo. Leyden, 1761; *Loesner's*, 8vo. Leipsic, 1774. There is a translation of Callimachus into English verse, by Dr Tytler, 4to, London, 1793. (*z*)

CALLISIA, a genus of plants of the class Triandria, and order Monogynia. See Botany, p. 91.

CALLISTHENES, a Greek historian and philosopher, was a native of Olynthus, a disciple and kinsman of Aristotle, and the contemporary of Alexander the Great, whom he accompanied in his expedition to the East. The austere temper, however, and unbending republican spirit of Callisthenes, were but little calculated for the meridian of a court, and upon several occasions he gave great offence to the haughty monarch, by the freedom of his reflections. At length, when Alexander came to the impious and frantic resolution of assuming divine honours, Callisthenes not only refused to join the other courtiers in flattering his pretensions, but addressed to him a spirited remonstrance on the subject; which, however, had no other effect, than to draw upon himself the implacable hatred of the prince. The conspiracy of Hermolaus furnished a pretext for implicating him in a charge of treason; though it does not appear that he was otherwise guilty, than by having uttered bold and unguarded expressions against tyranny. He was, however, arrested along with the other persons accused; and though it would seem that his fate was for some time suspended, it is certain that he suffered death in consequence of the charge which had been brought against him.

Callisthenes wrote a *History of the Actions of Alexander*, which is cited by several of the ancient authors. Many other works, which are not now extant, are also ascribed to him, or to some other writer of the same name. Among these are a *History of Greece*, comprehending 30 years from the peace of Antalcidas; a *History of the Trojan war*; a *Periplus*; *Persics*; *Macedonics*; *Thracics*; and *Metamorphoses*. See Arrian, *Exped. Alex.* Plutarch, *in Alex.* Quintus Curtius. Voss. *Hist. Græc.* Fabr. *Bib. Græc* (*z*)

CALLITRICHE, a genus of plants of the class Monandria, and order Digynia. See Botany, p. 78.

CALLIXENE, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 188.

CALMAR, a sea-port town of Sweden, and the capital of a government of the same name, comprehending the eastern part of Finland, and the Isle of Oeland. It is strongly situated upon the Baltic, opposite to the island of Oeland, from which it is separated by the straits of Calmar, about seven miles in breadth. The streets of this town are regular, and cross each other at right angles; and the new town is large, though not very populous. It is fortified with thick walls, built of pebble-stones found in the sea, and by a few earthen ramparts, supported by another wall, which the sea surrounds on all sides except at the gate. The avenues are either full of marshes, or are cut off by the sea, which beats upon a rocky coast. A long mole, built with stone, extends along the sea side, and is defended by Fort Grimskar, erected on a rock about fifty paces from the mole, and surrounded by the sea. A garrison is constantly kept in this fort. On an eminence behind the old town stands the castle, which has the sea on one side, and on the other ramparts, bastions, and ditches full of water. This building, which has been erected at different times, is a mixture of Grecian and Gothic architecture. The inscription "John III. 1568," is over one of the doors; but this must be the most modern part of the building, as the hall, 94 feet by 30, is still shown, in which the deputies of Sweden, Denmark, and Norway assembled, to choose their common sovereign. The palace, which was formerly the residence of the celebrated Margaret, is converted into a distillery. Calmar once occupied a different spot from what it does at present. In consequence of being burnt down in 1647, it was built near to the Isle of Quaraholm. The commerce of Calmar was formerly very considerable, but a great part of it has been transferred to Stockholm. It exports annually about 20,000 planks, 560 tons of alum, and a great quantity of hemp and tow. About 70 vessels, from 100 to 300 tons, are employed in this trade. Drabs and several other woollen stuffs are manufactured here. The town is nearly a mile in circumference, and contains about 500 houses. East Long. 60° 21′ 45″, North Lat. 56° 40′ 30″. (*π*)

CALMINA. See Calamo.

CALMUCKS, Oeloets, or Eluths, supposed to be the *Hippophagi* of Pliny, and other ancient historians, are a tribe of independent Tartars, and a branch of those nomadizing barbarians, who in the beginning of the 13th century, under the name of Moguls, and led on by Zengis Khan, subdued and desolated the finest provinces of Asia. They are the only Tartar nation that has retained the ancient language of the Moguls in all its purity. They have also preserved the manners, the dress, and the religion, which all historians have attributed to these conquerors; and their Contaish, or Great Khan, claims the honour of being the true descendant of the Great Zengis. The appellation of Calmuck was bestowed upon them by the Mahometan Tartars, as a term of reproach, on account of their pagan worship; but they pretend that they have a better right to the name of Moguls than their neighbours on the frontiers of China, now known by the name of Mongales; and indeed the territory of this people, in the beginning of the last century, embraced the very states which Zengis left as a patrimony to his successors, and comprehends the most considerable and richest part of Tartary. From the river Jaick, or Ural, on the west, their possessions extended along the southern boundaries of Siberia as far as the river Selinga on the east, and skirting the empire of China, they reached on the south towards the confines of the kingdom of Ava. Turning then to the north west, they were bounded by the Mogul empire, Great Bucharia, and Turkestan. These extensive territories, however, have been greatly curtailed by the encroachments of the Russians and the conquests of the Chinese.

The Calmucks were driven from Thibet in 1720, and about forty years after, Kiang Long extended his dominions as far as the mountains of Belur; so that such of the Calmucks as refused to submit to his authority, were compelled to seek for new settlements towards the west. Many of them dispersed themselves in the interior parts of Asia, and among the cities of the Usbeck Tartars; others took refuge in Russia: some thousands fled to Siberia; but the greatest number accommodated themselves to the Chinese sovereignty. At present the most numerous and powerful of the Calmuck hordes, according to Grosier, inhabit the country lying between the Caspian sea, Muscovy, Samarcand, and Cashgar. Others also occupy, with their flocks and herds, both banks of the Volga, between the Irghis and the Caspian, and extend their excursions on both sides of the Don and the Ural.

Before their subjugation and dispersion, the Calmucks were divided into three principal branches, viz. the Soongares, the Coschotes, and the Torgots. Of these, the Soongares were the richest and most formidable, and were engaged in almost perpetual hostilities with the Mongales and Chinese. They resided about the Balkhash lake, and its rivers Tschuy and Ily; and held in tribute the Great Kirgusian horde, and the towns of Little Bucharia. The Coschotes, upon the conquest of Thibet, became subject to the Chinese, and still continue under the protection of that power, except a smaller part which had retired to the Irtish, and fell under the dominion of the Soongares. Those under the dominion of China are estimated at 50,000, and are said to have derived their name, which implies warrior or hero, from the courage which they displayed in the wars of Zengis. The Torgots, who had separated from the Soongares, and had formed themselves into a particular horde, settled at an early period among the steppes on the Volga, and received from the Russians the appellation of the Volgaic Calmucks. But many of them being disgusted by the interference of the Russian government respecting the authority of their taish, or chan, returned in great numbers in 1770 and 1771, over the river Ural on the ice, and across the Kirgusian steppes into Soongaria.* These different branches, however, since their expulsion from their ancient habitations, have become so incorporated with one another, and are so assimilated in manners and customs, that most of them are ignorant of their particular origin. The Calmucks, according to Mr Tooke, are divided into three ranks; the nobility, who are called white-bones; the common people who pay tribute, and are termed black-bones; and the clergy. The noble ladies are also called white flesh, and the common women black flesh; but pedigrees are reckoned only by the bones. The tribute is about the tenth part of their cattle and other property. In the time of war, upon the first summons, every man must appear on horseback before the prince, who dismisses such as are unfit for service. All the subjects belonging to one prince are termed an *oluss*, and are divided into *imaks*, each containing from 150 to 300 families, and commanded by a *saissan* or noble. But though each oluss has its petty prince, or taish, yet they all acknowledge more or less the sovereignty of the Contaish, or Great Chan of the Calmucks, whose authority is considered as a right perfectly established and sacred, but whose interference is only admitted in affairs of general importance.

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* Among the specimens of Calmuck poetry which Mr Tooke has published in his valuable work on the Russian Empire, is an elegy written upon the occasion of their departure from the Volga, which we present to the curiosity of our readers:—

"The waters of the vast ocean,
When it has raged with all its fury, becalms itself again;
This is the course of the world; and likewise still to forget.
Ye white herds, with the marks of Schæbiner!
Thou prince Schereng, in the van as conductor,
Riding on thy noble reddish bay horse;
The Prince Zebek following with his numerous troop,
Ah! Ubaschakhan, conduct as now the Torgots!
There over rocks, over stones, and rough places,
The herds drag themselves along, and become lean,
By flying over the land all covered with snow and frost.
Ah! how the droves trot over the snow!
Now you are got thither, and come to your resting place.
Why was there any quarrel between thee and the white Chan †
Ye otherwise peaceful Torgots between the Yaik and the Volga,
How far ye now retreat!
Ah! the beautiful Volga (Idshel) is abandoned by the Torgots;
Ah! the lovely stream of Mazak is now likewise become an orphan.
Ah! thy many excellent young princes,
Ye are now all marched far away over the Yaik.
Ah! thou well arranged troop of Torgots,
Art now perhaps arrived at the Irtish (Ertschis).
Ah! helpless lamentable time!
Thou excellent host of warriors marching towards Altai,
Ye have no princely women among you!
Fare ye well, ye who bring up the rear of the horde,
Princes Aksakal and Kirep!"

† The Czar of Russia.

The Calmucks are distinguished from the other nations of Asia, by their peculiar habits and appearance. They are, in general, of a middle size, athletic, and well made; and the only defect which is common among them, is their having the thighs and legs somewhat bent. Their countenance is at first extremely forbidding; a large head, round face, dark olive complexion, high and prominent cheek bones, small sparkling black eyes, widely separated from each other, a flat broad nose, scarcely rising above the level of the face, and turned up, exposing to view two immense nostrils, thick and fleshy lips, exceedingly white teeth, a short chin, a thin and scanty beard, and black coarse hair, tied up in a long queu behind, are the characteristic features of a Calmuck. Frightful as this picture may appear to us, it is those who possess these characters in the highest degree, that are regarded among them as the most beautiful. Many of the women, however, have rather agreeable features, and very delicate complexions, which are set off by the fine black of their hair; and some of the higher classes among them would even be considered as beauties by Europeans. The dress of the men consists chiefly of a shirt and drawers, made of cotton, or sometimes of sheep-skin; a small round bonnet trimmed with fur, and ornamented with a tuft of silk, or horse hair of a red colour, and immensely large boots. They have also a kind of doublet made of sheep-skin, and without sleeves, which, in the northern provinces, they wear over the shirt. In summer many of them go entirely naked, except a cloth bound round their waist. A cotton shirt is the only dress of the women during the summer; and, in winter, a long cloak of sheep-skin, and a bonnet the same as that of their husbands. They wear in their ears shells and large mock pearls, of a very irregular shape. The married women have their hair braided, which falls over their shoulders on each side of the face, and fastened at the end with bits of lead or tin, while a virgin has only a single braid hanging down the middle of her back. When equipped for war, however, many of the Calmucks wear a helmet of steel, with a gilded crest, from which hangs a net-work of iron rings as low as the eyebrows in front, and falling behind over the neck and shoulders. Their bodies are protected by a coat of mail, formed of iron or steel rings netted together, which adapts itself to the shape, and yields readily to all the positions of the body. These are manufactured in Persia, and are reckoned as equal in value to fifty horses. But a cheaper sort, made of scales of tin, sell for only six or eight horses. Their arms are bows and arrows, lances, sabres, and poignards. Fire-arms are confined to the higher orders, and are kept with great care. Their best bows are made of the wild goats horn or whalebone, and the common kind of maple, or thin slips of elm or fir fastened together, and bound with a covering of linden or birch bark.

The Calmucks are of a social and hospitable disposition, faithful to their chiefs, exceedingly affable, and eager to oblige. They possess a vivacity and good humour, which never forsakes them, even in their most wretched state; for a Calmuck is scarcely ever seen dejected by sorrow, and is never subdued by despair. They are, however, slovenly and dirty in the extreme, completely destitute of true courage, and greatly addicted to cheating. "Within the tent," says Dr Clarke, "we found some women, though it was difficult to distinguish the sexes, so horrid and inhuman was their appearance. Two of them, covered with grease, were lousing each other; and it surprised us, that they did not discontinue their work, or even look up as we entered."—"The old women," continues this celebrated traveller, "were eating raw horse flesh, tearing it off from large bones, which they held in their hands. Others, squatted on the ground, were smoking, with pipes not two inches in length, much after the manner of the Laplanders." But these defects ought in some measure to be forgotten, in the many good qualities which they possess, and which render them so superior to the Mahometan Tartars. Robberies are very rare among them, except against a hostile tribe, and murder is almost unknown. They pay great respect to old age; and though of a choleric temperament, and exceedingly fierce when irritated, they live more amicably together than could be expected from their independent and migratory manner of life. If any one receives a present of meat or drink, he divides it faithfully with his companions; and if a relation has lost his flocks or other substance, by war or accident, he is sure to be most liberally assisted. "A Calmuck, provided with a horse," says Professor Pallas, "with arms and equipage, may ramble from one place to another for three months together, without taking with him either money or provisions. Wherever he comes, he finds either distant relations or friends, to whom he is attached by the ties of hospitality, from whom he meets with the kindest reception, and is entertained in the best manner their circumstances afford. Perhaps he lodges in the first unknown cottage he finds upon his road; and scarce has he entered it, but his wants are supplied with the most affectionate cordiality. Every stranger, of whatever nation, never fails to be well received by a Calmuck; and he may depend upon having his effects in the greatest security, the moment he has put himself under the protection of his host; for to rob a guest is considered by the Calmucks as the most abominable of all crimes."

The tents of the Calmucks, which are their only habitations, and are in general use from the prince to the peasant, are all of a circular form, with a conical roof, and a hole at the top. They are constructed of cane or wood, and covered with felt, made of camel's hair or wool. Those of their chiefs are large and well furnished, having the floors covered with mats or Indian carpets, and their beds hung with rich curtains. An encampment of their principal hordes presents the appearance of a city, with regular streets, sometimes extending a mile in length; and containing numerous shops, where several of the more refined arts are practised in considerable perfection. They have artificers in copper, brass, and iron; sometimes goldsmiths, who make trinkets for their women, idols of gold and silver, and vessels for their altars; also, persons who are expert at inlaid work, enamelling, &c. "One very remarkable fact," says Dr Clarke, "and which I should hesitate in asserting, if I had not found it confirmed by the observations of other travellers,* is, that from time immemorial, the Oriental tribes of Calmucks have possessed the art of making gunpowder. They boil the efflorescence of nitrat of potass in a strong ley of poplar and birch ashes, and leave it to crystallize; after which, they pound the crystals with two parts of sulphur and as much charcoal; then, wetting the mixture, they place it in a caldron over a charcoal fire, until the powder begins to granulate." Upon the breaking up of an encampment, which, in summer, is generally done every eight or ten days, in order to go in search of fresh pasture, their first care is to dispatch some of their people, to find out a proper situation for the tents of the chan, the lama, and for the huts containing the idols. The tents are then struck, and, being so made as to take to pieces and fold up in a small compass, are packed upon the backs of the camels or oxen. The camel that is loaded with the most precious furniture is decorated with bells, and marches before, the rest following one behind another. On these occasions, the women are dressed in their best clothes; and beguile the tediousness of the journey with merriment and songs.

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* *Journal des Savans Voyageurs*, p. 434

As the riches of the Calmucks consist entirely in their flocks, it is from them they draw their whole means of subsistence. They never think of cultivating the ground, though they inhabit many extensive tracts of country, equal in climate and fertility to any in the world. Their herds roam at large over the most luxuriant pastures, which, when withered by the droughts of summer, they renew, by setting fire to the old grass. Upon these occasions, the flames will sometimes extend nearly 100 leagues; and, in fifteen days, the country is again covered with verdure.

A wealthy Calmuck possesses several hundreds of cattle, sometimes thousands; but ten cows, with a bull, and eight mares, with a stallion, are considered a sufficient independence. They have very few camels, as it is rather a delicate animal, and difficult to rear; and these are confined entirely to the rich and the priests. Their horses are small, but very swift, and are capable of galloping for several hours successively without injury, or of passing a whole day without drinking. They castrate the greater part of their male foals, and slit their nostrils, that they may breathe more freely when they run. When breaking them, they use neither saddle nor bridle. A straight girth is tied round the body, by which the Calmuck keeps himself firm in his seat, and the animal is abandoned to his fury in the open plain. Here he is allowed to run and toss himself till he is quite fatigued, when his rider urges him on with the whip, until his strength is almost gone. He is then saddled and bridled, and rode quietly about for some time, by which means he soon becomes perfectly tame. Their horned cattle are of a beautiful shape; and their sheep are the same as those which are found throughout all Great Tartary. They are exceedingly fat, with large tails, and broad pendent ears; and their wool is so coarse, that it is fit for nothing but making felt. Their principal food consists in the milk and flesh of their cattle; but horse flesh is esteemed the best. They are, however, not very delicate in this respect, as they eat not only such of their cattle and horses as have died of disease, but dogs, cats, marmots, rats, and almost every kind of wild beasts; and the poor sometimes even feed upon carrion. Their favourite dish during a journey, is a piece of flesh placed under the saddle of the horse, which, by warmth and pressure, becomes a tender and palatable steak. They eat also the roots of chervil, dandelion, and several other species of wild plants, which they use both r[illegible] and boiled. Of their milk they make a fermented liquor, called *koumiss*; from which they distil a spirit similar to brandy, which they call *rack*, or *racky*, and of which they are remarkably fond. The koumiss is generally made of mare's milk, which is always preferred to that which comes from the cow, as it yields three times more spirit. It is prepared by mixing a sixth part of warm water with any given quantity of warm milk, which in summer must have previously stood twenty-four hours, and in winter three or four days; to this is added a little old koumiss, by way of yeast, when the mass is agitated, and sometimes artificial heat is applied to produce the vinous fermentation. From this substance their rack is distilled; and Dr Clarke, who witnessed the process in a Calmuck camp, has given us the following account of it: "The simplicity of the operation, and of their machinery, was very characteristic of the antiquity of this chemical process. Their still was constructed of mud, or very coarse clay; and for the neck of the retort they employed a cane. The receiver of the still was entirely covered by a coating of wet clay. The brandy had already passed over. The woman who had the management of the distillery, wishing to give us a taste of the spirit, thrust a stick, with a small tuft of camel's hair at its end, through the external covering of clay; and thus collecting a small quantity of the brandy, she received it into the palm of her dirty and greasy hand, and, having tasted the liquor, presented it to our lips." This liquor is clear and weak, but the rich Calmucks increase its strength by a second distillation, and it is capable of being kept a long time in glass bottles. This people are also extremely fond of tobacco and tea; but, as the last article is very dear, and rather difficult to be obtained, the poorer classes supply its place with several kinds of wild plants, such as the seed of the sharp leaved dock, the root of wild angelica, the seed of the Tartarian maple, and a species of liquorice. Their principal amusements are hunting, wrestling, archery, and horse racing: indeed, the greater part of a Calmuck's time is spent in diversions. They are excellent horsemen, being trained to riding from their infancy. The women, however, are as expert at this exercise as the men, and manage the animal with more gracefulness and skill; for a male Calmuck on horseback, though he never loses his seat, appears as if he were intoxicated, and about to fall off every instant. So partial are they to this amusement, that even the ceremony of marriage is sometimes performed on horseback. "A girl is first mounted," says the intelligent traveller whom we have so often quoted, "who rides off at full speed. Her lover pursues; and, if he overtakes her, she becomes his wife, and the marriage is consummated upon the spot; after which she returns with him to his tent. But it sometimes happens, that the woman does not wish to marry the person by whom she is pursued, in which case she will not suffer him to overtake her; and we were assured, that no instance occurs of a Calmuck girl being thus caught, unless she has a partiality for her pursuer. If she dislikes him, she rides, to use the language of English sportsmen, 'neck or nothing,' until she has completely escaped, or until the pursuer's horse is tired out, leaving her at liberty to return, to be afterwards chased by some more favoured admirer." The Calmucks are passionately addicted to gambling, and will sometimes sit whole nights at cards, until they have lost all that they possess, even their very clothes. This game, however, is only permitted during their festivals, and at all other times is prohibited under a severe penalty. They have also chess, draughts, backgammon, and the young people amuse themselves with singing, and dancing to the *balalaika*, or two stringed lute. In their drinking parties, which are very frequent, and where every one brings his share of rack or koumiss, the greatest harmony and decorum prevails; and though they are generally kept up until the stock of liquor is expended, which sometimes lasts for half a day, yet they are almost never attended either with riot or intoxication.

The most common diseases to which this people are subject, are the itch and malignant fevers, which arise entirely from their gross diet and want of cleanliness; and during the heats of summer these last are sometimes very fatal. The venereal disorder, to which they give the name of the "house disease," as properly belonging only to such as dwell in houses, is not uncommon; but it chiefly prevails in those camps where their princes reside, and is not often found among the lower orders.

The religion of the Calmucks is pagan; and, were we to judge from their sacred pictures, approaches very near to the ancient mythology of Egypt and Greece. According to M. Bergman, the majority of them profess the religion of Thibet. Their priests are treated with great respect, and in all affairs of importance they are guided by their decision. They have two written characters; one of which is esteemed sacred, and is of the highest antiquity. It is only used in such writings as concern the Calmuck law, and is read from left to right, like the languages of Europe. The other, which is used in the common concerns of life, is read from top to bottom, and the letters are placed in columns. Such of them as possess an idol, place it near the head of their bed, with small consecrated cups full of milk, or other food, set before it; and in festivals it is decorated with garlands, and perfumes are burnt in its presence.*

The commerce of this people consists entirely in the exchange of their horses and cattle for corn, woollen cloths, linens, copper, pewter, kitchen utensils, knives, and spoons; and great numbers of them from the interior annually visit Astracan for this purpose. They are allowed to traffic with China, free of all duty; but they never deal in slaves, like their neighbours the Mahometan Tartars, who often go to war with no other intention but to procure human beings for the market; and who spare neither enemies, friends, nor children, when they wish to get rid of them. The prisoners taken in war by the Calmucks are incorporated into the nation, and swell the power and revenue of the prince. See *Recueil de Voyages au Nord*, tom. x. p. 253, &c. Clarke's *Travels in Russia, Tartary, and Turkey*, p. 236. and 332. Tooke's *Account of the Nations which compose the Russian Empire*, vol. iv. P. S. Pallas *Reisen durch verschiedene Provinzen des Russischen Reichs, in den Jahren* 1768 bis 1773, vol. i. Bergman *Nomadische Streifereien unter den Kalmuken*, &c. Grozier *Description generale de la Chine*, vol. i. *Histoire generale de la Chine*, tom. xi. p. 550; and *Edin. Trans.* vol. i. p. 178. See also CHINA, and TARTARY. (*p*)

CALNE, a town of England in Wiltshire, situated on the banks of the river Marlen, which supplies it with water, and gives motion to several fulling and corn mills. The town is clean and well built, and is supposed to have risen out of the ruins of a Roman colony near Studley, where several Roman coins have been found. The church dedicated to St Mary is a large building, and has a handsome square tower at the north-east end. The Presbyterians, Quakers, and Anabaptists, have each a meeting-house in this place. Under the patronage of the Marquis of Landsdowne, whose seat is at Bowood, about two miles from the town, the market-house has been greatly improved. In this place was one of the palaces of the West Saxon kings; and, from the names of Castle-street and Castle-field, it is supposed that there had formerly been a castle in the neighbourhood, though no traces of it have yet been discovered. There was also here an hospital of black canons, dedicated to St John. Broad cloth, serges, and other articles in the cloth trade, are manufactured here to a considerable extent, and are sent to every part of England by means of the Wiltshire and Berkshire canal, which runs close to the town. Calne sends two members to parliament, who are elected by its burgesses. The corporation consists of two guild stewards, who are elected every year, and an unlimited number of burgesses.

It was here that St Dunstan, archbishop of Canterbury, performed his famous miracle, in the reign of Edward the Martyr. At the great synod which had assembled to determine the controversy between the monks and the secular priests, the floor of the hall suddenly gave way, while Bishop Beornhilm was pleading for the priests; and a great number of the members were either killed or bruised by the fall, while the seat of St Dunstan alone remained firm. This artful prelate had ordered some of the beams of the floor to be sawn asunder, and had induced the king to abandon his intention of attending the synod.

On the London road, about three miles east of Calne, is the figure of a huge white horse, in a trotting attitude, which is formed by paring the turf from the side of a chalk hill. It measures about 157 feet from the head to the tail. Number of houses 755. Population in 1801, 3767, of whom 1977 were returned as employed in trade and manufactures. Population in 1811, 5062. (*π*)

CALOCHILUS, a genus of plants of the class Gynandria, and order Monandria. See BOTANY, p. 311; and Brown's *Prodromus Plant. Nov. Holl.* &c. p. 320.

CALODENDRUM, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 147.

CALOGYNE, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 169; and Brown's *Prodromus Plant. Nov. Holl.* &c. p. 579.

CALOMERIA, or HUMEA of Dr Smith, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See BOTANY, p. 305.

CALOPHYLLUM, a genus of plants of the class Polyandria, and order Monogynia. See BOTANY, p. 228.

CALORIC. See CHEMISTRY and HEAT.

CALORIMETER. See CHEMISTRY.

CALOSTEMMA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 190; and Brown's *Prodromus Plant. Nov. Holl.* p. 297.

CALOTROPIS, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 169; and Brown, *Wernerian Transactions*, vol. i. p. 28.

CALPIDIA. See PISONIA.

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* For a particular account of their religion, see THIBET.

CALTHA, a genus of plants of the class Polyandria, and order Polygynia. See BOTANY, p. 233.

CALUMET, an instrument in use among the Indians of North America, and universally regarded by them as the emblem of peace. It corresponds, in a great degree, to the flag of truce as employed among the nations of Europe.

In the New World, the mode of expressing by arbitrary signs, a disposition of amity towards strangers or rival tribes, is subject to considerable variations. Among the islanders of the Pacific Ocean, the usual indication of friendship, is the green branch borne aloft in the hand. On the western coast of North America, the Indians approached the English, under Captain Cook, presenting as they advanced, a staff or baton curiously wrought, and surmounted with a knot of feathers. But among all the savage nations, occupying the territory beyond the northern limits of the Spanish possessions, the symbol of peace is the tobacco pipe; and it is to this instrument exclusively, that the French have given the name of Calumet, and to which that name is at present very generally applied.

The calumet, or pipe of peace, is usually about four feet in length. The bowl of it is made of red marble, hollowed out with considerable art, and the stack is composed of a reed, or of some light wood, which is easily perforated. The Indians adorn this instrument in various ways. Sometimes it is marked with the figures of animals and hieroglyphical delineations; and almost universally, it has beautiful feathers attached to it, disposed in fanciful arrangements, according to the taste of the individual, or of the nation to which he belongs. And each tribe is said to decorate the calumet after a manner peculiar to itself. The instrument in question is frequently used by the savages when warriors of different nations accidentally meet; sometimes, even in the rage and tumult of a battle, it is offered and accepted, and hostilities instantly cease; and it serves with many accompanying solemnities, as an introduction to ambassadors, and as a medium of reconciliation and alliance among contiguous tribes. But in these last circumstances, namely, when ambassadors have arrived, and a treaty is about to be formed, the use of the calumet is deserving of particular notice. The strangers having appeared, and the chiefs of the nation which receives the embassy being placed, according to the degree of eminence which they have attained, an officer, belonging also to the nation which receives the embassy, and who in Europe would be styled an *aid-de-camp*, prepares the calumet, in order to present it to both parties, with the requisite observances. After filling the pipe with tobacco and fragrant herbs known to the Indians, the officer alluded to snatches a piece of burning wood, either from a neighbouring cabin, or from a fire which has been lighted on purpose, and places it upon the bowl of the instrument. The smoke gradually ascends, and when the odoriferous composition included in the pipe is sufficiently kindled, the piece of burning wood is removed. Here the first part of the ceremony appears to terminate. The officer, or aid-de-camp, next points the stem of the calumet towards the heavens, and by this action he is understood to supplicate the favour of the great spirit; he then turns it downwards towards the earth, and now he is supposed to avert the malignity of the evil genii, or charm them into quiescence; and finally, stretching forth the instrument in a horizontal direction, he moves himself round till he completes a circle; and by this last observance, he is conceived to invoke the spirits which inhabit the air, the woods, and the waters, and whose concern and delight it is, as the Indians believe, to provide for the happiness of mortals. The invocation of the benignant genii seems to conclude the second part of the ceremony. For immediately, yet not without some degree of politeness, according to the fashion of the savages, the officer presents the calumet to the chief of his own tribe, putting the extremity of the reed into his mouth. The chief, having received the smoke, blows a portion of it vigorously towards the heavens, and the rest all around him upon the earth. Tho pipe is next introduced successively into the mouths of the ambassadors, who blow forth in the same manner; but neither they nor the chief ever touch the instrument, except with their lips. The honour of presenting the calumet is always reserved for some person of distinction. And the whole ceremony is performed in a grave and dignified way, corresponding, in this particular, to the usual manners of the Indians, which are solemn and lofty, and bearing a resemblance, in most of its aspects, to a religious institution. The treaty is now concluded; the hatchet painted red, the awful emblem of war, is buried deep in the earth; a belt of wampum, by which the articles of agreement are recorded, is delivered; and the union, thus singularly, and, as we should say, fantastically formed and established, often continues throughout many generations.

From the calumet, and the use to which it is applied, the most elegant of the Indian dances has its origin and name. It is called the calumet dance; but when it is stated that this is the most elegant of the Indian dances, nothing more is meant, than that in the exercise or amusement alluded to, the contortions and gestures of the performers are less frightful than in any of the other dances. Like all the other dances, however, that of the calumet may be regarded as descriptive or emblematical; and its peaceful character might even be inferred from the known uses of the instrument. It appears to represent, by a series of movements, the power and utility of the calumet. These ideas are very obviously expressed in what may be called the chief action of the piece. In this principal part, the performers are commonly two; the one armed with a club or hatchet, and the other bearing in his hand the mediatory pipe, with which he defends himself against the attacks of his opponent, and with which he ultimately succeeds in reducing him to obedience. Both the performers dance all the while; and the rest of the Indians, usually seated around them, join with them in uttering and repeating that disagreeable sound which constitutes the music of the savages. The sound referred to, Mr Carver attempts to convey to European ears, by the words "heh, heh, heh," and it is pressed forth from the chest, apparently with much effort. The calumet dance, however, is now in use only upon rare occasions, as when ambassadors are received by the Indians, or when strangers of distinction pass through their country. See Carver's *Travels*, pp. 253, 194, 201; and Long's *Travels*, p. 35. (*k*)

CALVADOS, a department of France, which derives its name from a chain of rocks about 12 miles long, at the embouchure of the Orne, upon which a Spanish vessel of this name was dashed to pieces. This department is formed of that part of Normandy which comprehended the dioceses of Lisieux and Bayeux. It is bounded on the north by the sea, on the west by the department of La Manche, on the south by the department of the Orne, and on the east by the department of the Eure. The principal productions of this department are all kinds of grain, excellent pasturage, hemp, lint, wool, white and red honey, wax, cider of the first quality from Auge and Bayeux, fish of all kinds, shell-fish from the rocks of Calvados, white coral, woad, coal, and iron. The river Orne is navigable from Caen to the sea; the Foucques is navigable from Lisieux to the sea; and the Dive from St Pierre to the sea. The Seull forms at its embouchure the small harbour of Caerreule, where the oysters of Cancale are brought to be enclosed. The principal towns are Caen, Falaise, Lisieux, Bayeux, Vise, Pont L'Eveque, each of which is the capital of a communal district. The superficies of this department is 5700 square kilometers, or 375 square leagues, of 2000 toises. The forests contain 36 or 37 hectares, about 70,000 arpens, one half of which belong to the nation. Contributions for the year 1803, 6,348,465 francs. Population 506,000. (*o*)

CALVARY. See Jerusalem.

CALVIN, or Cauvin, (John,) the celebrated reformer, was born at Noyon, in Picardy, on the 10th of July 1509. His father's name was Gerard Calvin, and his mother's Joanna Franca; persons of respectable character, but by no means in affluent circumstances. From his earliest years he lived in the family of Montmor, which was of some distinction in the country, and received there, though at his father's expence, a very liberal education. He then accompanied the children of that family to the college of La Marche, in Paris, and studied under Marturin Cordery, a man of equal probity and learning, and celebrated throughout France as a teacher of youth. Leaving the college of La Marche, he went to that of Montaign, where, under the tuition of a learned Spaniard, he made the most rapid progress in the elements of literature. Outstripping all his companions, he advanced quickly from the study of the languages to dialectics and philosophy. His father having always observed in him an uncommon degree of piety and moral virtue, concluded that he should be consulting the young man's inclinations, by devoting him to the sacred office; and accordingly he procured for him (in 1521,) from the bishop of Noyon, the Chapel de la Gesirie, in that city. In 1527 he obtained the curacy of Marteville; and two years after he exchanged it for that of Pont L'Eveque. There he preached several times, though he had not received any regular ordination, nor was any farther an ecclesiastic than by simple tonsure. But it was not long till Calvin's views, as well as those of the father, completely changed with respect to the profession which he had adopted. Having acquired some correct notions of Christianity, from the instructions of his relation, Robert Olivetan, and from a careful perusal of the scriptures, he became disgusted with the superstitions of Popery, and had actually begun to withdraw himself from the Romish communion. Gerard, too, finding that to remain in the church was not the most likely way of advancing the worldly interests of his son, was perfectly willing that he should abandon the church, and betake himself to a more profitable line of life. The study of the law was fixed on as a department in which Calvin himself expected at least to enjoy greater liberty of conscience; and which his father regarded as one that would be productive to his favourite child both of opulence and fame. In pursuance of this design, he went to Orleans, where the civil law was taught by Pierre de l'Etoile, the greatest of the French civilians, and afterwards president of the parliament of Paris. There he made such great and rapid proficiency, that he very often supplied the place of the professors in their absence; and they unanimously and gratuitously offered him, when he was leaving the university, a doctor's degree, as a just tribute to his superior talents, his great diligence, and his high attainments in legal science. Although, however, he applied chiefly to law, he did not neglect the study of theology. And so much was he respected on account of his acquaintance with that subject, that all those in Orleans who were desirous to know any thing of the pure doctrines of religion, had frequent recourse to him for information; and on these occasions they had equal reason to admire his erudition and his zeal. At this period of his life he was a remarkably severe student. So incessant and laborious was his application, that while it greatly improved his intellectual powers, and provided him with a rich fund of knowledge, it also induced that weakness in his stomach which was afterwards the source of much distress to him, and at length shortened his days. From Orleans he went to Bourges, and there prosecuted his professional studies, under Andre Alciati, one of the most noted civilians of his age. At Bourges, he contracted an intimate friendship with Melchior Wolmar, professor of Greek, a man distinguished for his personal worth, and his skill in teaching. With his assistance Calvin acquired the Greek language, a benefit which he always recollected with pleasure, and for which he afterwards testified his gratitude, by dedicating to Wolmar his *Commentary on the 2d Epist. to the Corinthians.* Amidst all his other pursuits, Calvin still persevered in sacred study, and sometimes preached in Ligneres, a small town in Berri, with the permission and in the presence of the governor of that district.

The sudden death of his father called him back to Noyon, where, however, he remained but for a short time. He went to Paris in 1533, being then 23 years of age, and wrote a commentary on Seneca's book *De Clementia.* It was in the title page of this work that he first took the surname of Calvin, instead of Cauvin, which it had hitherto been; a circumstance which his enemies have weakly and maliciously perverted to his prejudice, and of which, if an explanation be thought necessary, a sufficient explanation may be found in the *Defense de Calvin par Drelincourt.* He soon became known to all the friends of true religion, among whom was one Estienne de la Forge, a celebrated merchant, who was afterwards burned for his attachment to the gospel, and of whom Calvin makes honourable mention in his Treatise against the libertines. While at Paris he formed the resolution, which he immediately carried into effect, to the unspeakable satisfaction of the reformed in that city, of abandoning every secular pursuit, and consecrating himself to the service of God. He had scarcely entered on his new course, when he was subjected to severe trial. Nicholas Cop, rector of the university of Paris, having delivered a speech which gave great offence to the Sorbonne and the parliament, was summoned to appear before them, and answer for his conduct; but by the advice of his friends, he declined compliance, and left the kingdom. Calvin, who was an intimate friend of Cop's, and known to have furnished him with materials for the obnoxious speech, was the next object of their vengeance. Marin, the bailiff, a cruel and relentless bigot, was sent to his room in the college of Fortret, for the purpose of apprehending him; but he was fortunately from home. His papers and books, however, were seized, and as there were among them several letters from his friends, containing heretical and exceptionable matter, and alluding to those who were hostile to the Romish church, many were on the very point of being subjected to a cruel persecution. But this was prevented by the humane interposition of the Queen of Navarre, who employed her influence with the king, and employed it successfully, in favour of the reformed. This princess sent for Calvin at the same time, gave him a very favourable reception, and listened to him with interest and attention. Immediately after the interview, equally honourable to Calvin, creditable to the queen, and useful to the reformation, he retired to Saintonge, where, at the request of a friend, (Lewis de Tillet,) he wrote some short *Christian Exhortations*, to serve as homilies in the several parishes, and to accustom the people by degrees to search after the truth. He also paid a visit to Le Fevre d'Estaple, who had been tutor to Frances I., and had taken shelter at Nerac from the storm of persecution. This aged saint received him joyfully, and predicted that he would yet be a remarkable instrument in the hand of Providence for the restoration of true religion in France. Calvin returned to Paris in 1534. There he was to have had a conference with Servetus, who had by that time begun to propagate his heterodox opinions respecting the Trinity; but Servetus failed to appear, though Calvin attended at the time and place appointed, and did so at the imminent hazard of his life; for this year was peculiarly troublesome and dangerous to the reformed. The king, exasperated by their firmness and successes, and particularly incensed at some of their writings against the mass, which had been posted on the door of the Louvre, commanded eight of them to be burned alive; and swore that he would not spare even his own children, if they were infected with such abominable heresies. To avoid the persecution, which had thus assumed such a violent and bloody aspect, Calvin was determined to quit the kingdom, which he did, after having published a treatise, entitled *Psychopannychiam*, against those who maintain that the soul sleeps after it is separated from the body.

Accompanied by Lewis de Tillet, he went to Basil in Switzerland. There he studied the Hebrew language, to which he had not hitherto directed his attention; and there he first published his greatest and most celebrated work, the *Institutions of the Christian Religion*. He was anxious to remain for some time in obscurity: but the calumnies circulated by high authority against the cause which he had espoused, rendered this impossible, and obliged him to come forward as its public advocate and friend. Francis I. in order to apologise for his late inhumanities, and to conciliate the German princes, whose friendship he needed, and whose resentment he had reason to fear, endeavoured to persuade them that it was only Anabaptists that he had put to death, and that, therefore, he had merely attempted to crush a sect that was equally obnoxious to them and to him. Calvin's indignation was roused by this insidious conduct, and he composed his Institutes for the purpose of vindicating himself and his Protestant brethren, and of shewing unequivocally and distinctly the tenets which they held. The first edition of the Institutes (which Maimbourg and Spondanus say was written in French, but which, it is probable, was written at the same time in Latin,) was published in 1535 in 8vo, and was only the rough sketch or outline of what the author afterwards produced. The second edition appeared in 1536, at Strasburgh, in folio, and was both larger and more correct than the first. The third edition was printed at the same place in 1543, and was still more complete. A fourth edition came out also at Strasburgh, with considerable improvements. A fifth edition in 4to was printed at Geneva in 1550, corrected in many places, and having two Indexes. In 1558, both the Latin and French editions received the author's last revision. Since that period the work has gone through a vast number of editions, and has been translated into almost all the modern languages; a circumstance which alone is sufficient to demonstrate its real excellence. This work, indeed, whatever may be thought of its doctrinal merits, is, as a system of theology, entitled to much admiration. The peculiarities of the system may be condemned, though it will be found difficult to disprove them; but the learning, the scriptural knowledge, and the philosophical ability with which they are at once developed and supported, must be acknowledged by all whose minds are not the victims of religious or political prejudice. With respect to the Latinity of the Institutes, it has obtained the applause of every competent judge. In particular, the Dedication, which is addressed to Francis I. has been universally admired, both for the sentiments and language; and is one of the few prefatory pieces which are generally allowed to stand highest in this species of composition. Just when Calvin was finishing the Institutes, he heard that in many parts of Italy there were symptoms of attachment to the reformation. He therefore hastened to the Duchess de Ferrara, daughter of Louis XII., a woman of distinguished accomplishments and exemplary piety, and one to whom the Protestants looked with some confidence and expectation. Acquainted with his merits, and qualified to appreciate them, she received Calvin with distinction; and while he confirmed her in her principles, she conceived for him an esteem which she cherished ever after, and expressed in a great variety of letters. He was not, however, allowed to remain long at the court of the duchess. The Inquisition got notice of his arrival, and soon compelled him to depart. It was probably at this period that he visited Piedmont, and preached the reformation there with success, though he was afterwards banished from it by intolerance. A pillar was erected at Aost, to commemorate his arrival and his expulsion.

From Italy Calvin went to France; but the persecution which was raging there, determined him to return to Basil or Strasburgh. The direct road being rendered impassable on account of the war, he was under the necessity of going by the way of Geneva. On his arrival there in August 1536, he found that the reformed religion had made considerable progress, in consequence of the exertions of Farel and Viret. Having gone to pay his respects to them, Farel most earnestly entreated him to remain in that city, and to help them in the important work in which they were engaged. And when Calvin obstinately declined the invitation, Farel addressed to him a solemn warning in the name of the Almighty, declaring that God would not bless his designs, since he preferred his own repose to Jesus Christ. The solemnity of this appeal, in connection with the extraordinary incidents which had brought him to Geneva, and the prospect which he had of being in a high degree useful to a cause which he had deeply at heart, subdued Calvin into an entire acquiescence in Farel's proposal. And accordingly he accepted of the office which the consistory and magistracy had offered him, with the consent of the people, by becoming both their preacher and professor of divinity.

He was no sooner installed, than he set himself seriously and zealously to the discharge of his public duties. He composed a *Formula of Christian Faith*, accommodated to the Genevese, who were just emerging from the corruptions of Popery: and to this he added a *Catechism*, embracing the chief points of religion. In the following year, (1537,) he succeeded, with the help of Farel and Corault, in making the senate and people openly abjure the church of Rome, and swear to a summary of doctrine and plan of discipline which he drew up for them, and which distinctly recognised the Presbyterian form of church government. Various circumstances occurred, however, to counteract his efforts, and to give him personal trouble. The Anabaptists opposed him, and laboured to overturn what he had established. But he confuted them so completely in a public disputation, that they never afterwards gave him any disturbance. A turbulent outcast from the Sorbonne, of the name of Peter Caroli, also endeavoured to bring him into discredit, by accusing him of heretical tenets respecting the Trinity. The subject was brought before the synod of Berne, which, after various discussions, found Caroli guilty of defamation. He was exposed, however, to evils of a more serious and invincible kind. Though the Genevese had agreed to the reform in religion which Calvin and his colleagues had introduced, and professed submission to the ecclesiastical authorities which had been instituted, yet a great proportion of them remained quite unchanged, in their principles and practice, and addicted as much as ever to those impurities in which they had formerly indulged. Besides this, a great deal of animosity between families and individuals had been engendered during the war of Savoy, which continued to burn, and to produce effects the most inimical to religion. Calvin and the other ministers did every thing in their power to correct these errors. They preached against them with the greatest energy. They used all their official influence; and applied to the civil power for its interference in behalf of public morals. But these attempts only excited the resentment of those whose unworthy conduct had called for them; and the more vicious and refractory of the people now wished for nothing but to relieve themselves from the jurisdiction of such vigilant pastors. Some differences which had occurred with respect to the administration of the Lord's Supper, gave encouragement and facility to the execution of that design. Not only had Calvin and his associates refused to administer the Lord's Supper at all to the Genevese while so much immorality and strife prevailed, but they maintained opinions with respect to the celebration of this ordinance, and certain other ceremonial points, opposite to those which seem to have then been received in that district of the Protestant church. The church of Geneva made use of leavened bread in the eucharist: they had removed the baptismal fonts as unnecessary appendages; and abolished all the festivals except Sunday. The churches of the canton of Bern disapproved of their practice in these particulars, and by an act made in a synod held at Lausanne, required them to change it. To this order Calvin and his brethren refused obedience. And the syndics, or chief magistrates, who were their greatest enemies, taking advantage of that fact, and making it seem as an aggravation of their other offences, assembled the people, and procured an order from the council, for the immediate expulsion of Farel and Calvin. When the sentence was communicated to Calvin, he said, "Truly, if I had served men, I would have had a poor reward; but it is well that I have served a Master who never forgets to pay his servants all that he has promised."

Calvin retired to Strasburgh, where, through the influence of Bucer and others, he was appointed professor of theology, and pastor of a French church, which he modelled according to the form adopted at Geneva. Notwithstanding the harsh treatment which he had received from the Genevese, he still remembered them with affection; and this affection he displayed in writing to them several letters, full of wholesome instructions, tender remonstrances, and encouraging prospects. He was particularly successful and happy in an answer that he wrote for their use, to a letter of Cardinal Sadolet, Bishop of Carpentia, in which that artful priest endeavoured to recal them to the Romish communion. The reply of Calvin was so able and eloquent, that he abandoned his project. While at Strasburgh, he published an excellent treatise on the Lord's Supper, produced a new edition of his Institutes, was useful in reclaiming many Anabaptists, and was appointed in 1541, by the divines of that city, to attend the diet convoked to meet at Worms, and afterwards at Ratisbonne, for settling the religious differences which had arisen in Germany. He went there with Bucer; had a conference with Melancthon, who was highly pleased with him, and called him, by way of eminence, *the theologian;* and proved highly useful to the protestant churches, especially to those of France.

The Genevese had now repented of their unjust banishment of Calvin, and longed to enjoy again the benefits of his instruction and authority; and, after much solicitation on their part, he consented to return. His arrival, which happened in May 1540, was welcomed with the acclamations of the people, and being released from his engagements at Strasburgh, in a manner honourable both to himself and to the magistrates and inhabitants of that city, he took up his permanent residence in Geneva. The first object which engaged his attention was the reformation of public morals. And for this purpose, he projected a kind of police, and procured the establishment of a tribunal called the Consistory, with power to take cognizance of all offences, and to inflict canonical punishments, even to excommunication. In cases requiring the infliction of severer penalties, it reported to the council of the city, with its own judgment on the evidence adduced. It was originally composed of laymen and ecclesiastics; and to shew Calvin's moderation with respect to church power, the number of the former was most considerable. This new institution was sanctioned by a law passed in an assembly of the whole people, who solemnly promised to conform to it for ever. It was reprobated by many as savouring too much of Romish tyranny; but there can be no doubt that its operation was attended with the most beneficial effects, and that it contributed, in a remarkable degree, to the preservation and prosperity of the republic. The labours which Calvin now performed were so various and so great, that it seems wonderful how he sustained them. He preached daily during every other week; he gave three lectures every week in theology; attended regularly the meetings of the consistory and of the pastors; met with his congregation every Friday; gave frequent instructions to the French churches, which appear to have depended almost wholly on his counsel; vindicated and defended the Reformation against its numerous enemies; composed various books of controversy; kept up a wide and extensive correspondence with the Protestants; produced works of learning and ability, intended for general edification; and did all this amidst much agitation and disquietude, occasioned by the inflexible severity with which he maintained the rights, and enforced the authority, of the consistorial tribunal. Nor was this the whole. The council in Geneva, knowing his attainments in the science of law, consulted him in all important matters. They particularly employed him in framing their edicts and laws, which were completed and approved in 1543. And, in short, he was the person to whom they applied in all their difficulties, as one whose talents, eloquence, and influence, rendered him competent to any task prescribed by the circumstances of a turbulent people, and a rising government.

The deference shewn to Calvin's opinions, and the respect paid to his personal character, were astonishing. His disapprobation of any tenet was sufficient to procure its rejection, and all who treated him ill were considered as enemies of the state. Castalio having attempted to disseminate some doctrines which Calvin abhorred, was instantly denounced as a heretic, and obliged to leave Geneva. And James Gruet, who was beheaded there in 1547, was condemned to death, not only on account of impiety and treason, but also for having spoken disrespectfully of Calvin, and endeavoured to injure his credit at the court of France.

But while Calvin was universally esteemed and respected in the reformed church, he was at the same time equally feared and hated by that church from which he had separated. Of this, a remarkable proof occurred in 1551. Being seized with a fit of ague during sermon, and obliged to quit the pulpit, the report quickly spread that he was dead. This report was heard with the highest satisfaction by the Catholics; and in Noyon, as Calvin himself has recorded, there was a solemn procession by the canons, to thank heaven for the death of that arch heretic, whom their city had been so unfortunate as to produce. Beza, by mistake, makes this incident to have happened in 1553.

For some time he had a great deal to do in the way of controversy, and wrote innumerable tracts in defence of sound doctrine. He contended with Castalio, who translated the Bible into Latin—with the Sorbonne, who had drawn up some articles of faith, to impose on the weak and timid—with Albert Pighius, a profound sophist, who had attacked the reformed church—with the Nicodemites, who secretly embraced the Protestant faith, but through fear still adhered externally to the church of Rome—with a monk at Rouen, who was reviving the heresy of Carpocrates, the Gnostic and Antinomian—with the Catholics, against the doctrine of the council of Trent—with those who believed in judicial astrology—with Lælius Socinus, author of the sect that derives its name from him—with Osiander and others, who imprudently revived the dispute respecting the Lord's Supper—and with the Anabaptists and libertines, who had revived the worst errors of antiquity. In this last case, the work which he published offended the queen of Navarre, to whom he, on that account, wrote a remonstrance, distinguished by a happy mixture of boldness and address; and he was so fortunate as to succeed in appeasing her, and in accomplishing, at least, the partial discomfiture of the sects which he had attacked. He had also a keen controversy with Jerome Bolzec, a Carmelite friar, who impugned his peculiar doctrine of absolute predestination, and openly taught the sentiments on that subject which were afterwards maintained by Arminius. They disputed the point in church; but Calvin displayed such a superiority in argument and erudition, that, in the judgment of all present, he obtained the victory; and, according to custom, his antagonist, who, besides his difference with Calvin, was of a troublesome temper, was first cast into prison, and then banished from the city. His chief contentions, however, were with the profane and profligate part of the inhabitants of Geneva. The strictness and impartiality of that discipline which was exercised by means of the new consistory, subjected him to much odium, and false accusation. But he persevered in his purposes, and triumphed over all opposition. He had the happiness to see the Genevese church increase rapidly, and the faction of the seditious gradually subdued: And these things, together with his habitual piety, supported him under the severe trial which he met with about this period in the loss of his wife, a woman of uncommon virtue and merit.

It is said that Calvin did not confine his views on doctrine and discipline to the church of Geneva; that he formed the splendid design, and entertained the sanguine hope, of making these a model for every other protestant church in Christendom; and that he proposed to send forth from the little republic, those succours and ministers that were necessary for accomplishing that important object. For that purpose, and also with the view of forwarding the general cause of the reformation, he established an academy in Geneva, which the senate founded at his desire, and in which he himself, with other divines of learning and ability, taught the sciences with much reputation and success. And so great was the fame which this seminary acquired, that it was repaired to by a crowd of students from England, Scotland, France, Italy, and Germany; and none who were anxious to make proficiency either in sacred or profane literature, thought themselves right till they had attended it a considerable time.

In 1553, Michael Servetus, a Spanish physician, who had settled at Vienne in France, and acquired a great professional character, published a work, entitled, *Restitutio Christianismi, &c.* which contained doctrines so unscriptural, that it was reprobated even by the Papists, who actually condemned him to be burnt for heresy. Besides this work, he had written one, *De Trinitatis Erroribus*; and another, *In Ptolemeum Commentarius*; he had also published an edition of the Bible, and addressed a letter to Paupin, a Genevese minister; and in all of these productions, he had departed very widely from the most generally received doctrines of Christianity. Having escaped from Vienne, and happening to come to Geneva in his retreat to Naples, Calvin, who was well acquainted with his principles and his character, and to whom his daring impiety and presumptuous insolence had become intolerable, at length procured his apprehension and imprisonment. He was brought to trial. After various delays, he was sentenced to be burnt alive, for having "set himself in array against the Divine Majesty and the Holy Trinity;" and the dreadful sentence was executed that same day on which it was pronounced. Every candid judge and enlightened friend of toleration will acknowledge that the conduct of Calvin in this affair cannot be vindicated or justified. It was altogether unworthy of such a man, and must be regarded as a blot in his otherwise great and good reputation. But while this is freely conceded, a similar concession cannot be made to the enemies of Calvin, with respect to that outrageous clamour which they have raised and propagated against him for his treatment of Servetus;—a clamour which seems to have arisen, not so much from a calm consideration of Calvin's real demerit, as from an unreasonable prejudice against the man, transferred from the system of doctrine which he maintained, or from a strong feeling of hatred to intolerance, unchastened by a knowledge of the circumstances of the case in question, and of the history of the times in which the obnoxious transaction took place. Calvin, doubtless, went far wrong in sanctioning the punishment of Servetus; but his error was the error of his age, and of his country; and, in proof of this, a thousand facts might be adduced. Heresy in religion was universally regarded as equally criminal with transgressions of civil law, and punished with the same severity. The principles of toleration were as yet but imperfectly understood. Even those who formally recognised them, had not imbibed their genuine spirit. And the persecuting temper of Popery was insensibly retained, after men had discovered its corruptions, and emancipated themselves in a great measure from its yoke. This was the case in every place where the reformation existed, and with every sect of Christians that was possessed of power. When, therefore, Calvin is reprobated for procuring the death of a heretic, he suffers in common with all his brethren; and the condemnation passed upon him, is not because he acted worse than others, but because he did not surpass them in tolerance, as he did in every thing else. It should be recollected, too, that the punishment of heretics was not only permitted, but positively required, by the constitution of Geneva. And that to have allowed Servetus to escape, would have been an abandonment of that purity and zeal, by which the subjects of that constitution considered it to be distinguished, and which they had often displayed in prosecuting with eagerness the abettors of false doctrines. It appears, too, that the proceedings against Servetus received the approbation of almost all the most eminent ecclesiastics who then flourished. The reformed Swiss cantons were unanimous in exhorting the council of Geneva to *punish the wicked man, and to put it out of his power to increase heresy*. Farel, Viret, Bucer, Beza, Œcolampadius, and even the gentle Melancthon, approved of the measure. And why are not *they* subjected to the same censure as Calvin? The only person who was bold enough to oppose it was Castalio, whose well known grudge at Calvin, and a tendency to error in other points, sufficiently account for this departure from the prevailing sentiment. It may be farther remarked, that Servetus was a heretic of a peculiar cast. He did not merely maintain Socinian doctrine, but held principles and language, with respect to the nature of the Supreme Being, which amounted to blasphemy, and were not far, if they were at all, removed from Atheism. This is hinted at in the terms of his sentence, and distinctly asserted by some writers, who were very unfriendly to Calvin. Such conduct on the part of Servetus, as it greatly exceeded the ordinary bounds of heresy, would be deemed at that time more than enough to justify the opinion of one who said, that "he deserved something worse than death." It should be noticed, also, that Calvin himself had been accused of error with respect to the Trinity; and that, had he connived at Servetus, or dealt very gently with him, the suspicions formerly entertained of his own orthodoxy, might have been revived and confirmed. And the personal feeling which, in this view, he must naturally have experienced, would be strengthened, by recollecting that the doctrine of Servetus, respecting the divinity of Christ, was almost universally accounted heresy, both by Papists and Protestants; and consequently, that, considering the existing laws and notions in regard to it, and the favourable opportunity which he had of checking it, any coldness, or reluctance on his part, would have been construed into a perfect indifference to Christianity at large. It is not true, however, that Calvin shewed any undue eagerness to procure the destruction of Servetus. Much has been alleged to this purpose by his enemies; but it has no foundation in fact. He acted in this case, as he uniformly did, from no party view, or paltry resentments, but from a strong sense of duty, and an ardent love to truth. What he did in it, indeed, he did with his characteristic steadiness and zeal. It is evident, however, that his chief anxiety was, not to punish Servetus, but to make him retract his error. He tried most earnestly and patiently to prevent the catastrophe which followed; but this design was frustrated by the obstinacy, the violence, and the impious language of Servetus himself. Even after this unhappy man was condemned, Calvin felt for him; and though he could not get the execution of the law suspended, endeavoured, but in vain, to procure a remission of the more harsh and painful parts of the sentence. These observations are made, not to exculpate Calvin, or to justify the use of fire and faggot in defence of the gospel, but merely to do justice to the memory of this great reformer, and to moderate the hostility and lessen the confidence of his enemies.

After the year 1553, Calvin's life was comparatively tranquil. He was occasionally distressed with intestine divisions, respecting the exercise of discipline in Geneva. He found it necessary to engage in controversy with some heretics, particularly Valentine Gentilis, who vented some crude absurdities on the doctrine of the Trinity. Above all, he was deeply afflicted by the cruel and bloody persecutions to which the Protestants were exposed in Paris, where no fewer than twenty-one of that proscribed class were burned alive. Still, however, his troubles were neither so severe, nor so numerous, as they had hitherto been; and he had the unspeakable satisfaction of seeing the reformation prosper, in spite of all the power and artifice and malignity by which its progress was opposed. And he even succeeded in composing the disturbances which had reigned in the city, in defeating those heretics who had attempted to corrupt the gospel, and in putting a stop to the persecutions which had raged so violently in France, though they afterwards broke out with their wonted fury.

On the 2d of February 1564, Calvin preached his last sermon, and delivered his last prelection in theology. He laboured under a vast complication of disorders, which the skill of the best physicians was unable to remove; but under all of which he maintained the dignity and cherished the piety of a Christian. On the 10th of March, he was visited by Beza and other friends, to whom he spoke with the greatest cheerfulness and composure of his approaching dissolution. Being carried to the council on the 27th, he thanked them for all the affection which they had shewed him; and having said, "I feel that I shall not again have the honour of appearing in this place," he took his leave of them weeping.—Though much reduced, he attended church, on the 2d of April, and received the sacrament from the hands of Beza, listening also to the sermon, and joining as well as he could in the psalmody. The congregation, though they grieved at the prospect of his departure, were yet delighted at seeing the calm serenity and holy joy which beamed upon his countenance. On the 25th, he made his will, in which, besides bequeathing the little property, and it was but little that he had, to his relations, he gave a concise statement of his experience and his sentiments, and bore his emphatic testimony to the doctrine of salvation by grace. Having thus made his will, he was anxious once more to address the four syndics in their assembly; but on account of the state of his health, they waited upon him, when he spoke to them in the most earnest manner, expressing his gratitude for their kindness, giving them many wholesome admonitions, suggesting to them topics of comfort, and supplicating for them the blessing of heaven. He then shook hands with each of them, and bade them farewell. They departed with tears and sorrow. On the 28th of April, all the ministers of the town and neighbourhood being assembled in his room, according to his desire, he delivered to them a parting address, exhorting them to fidelity, charity, stedfastness, and perseverance, and encouraging them, by mentioning the success which had attended his own labours. His ancient friend Farel, venerable for his piety and his years, came from Neufchatel to have a last interview, which was tender and affecting. After this, he devoted his few remaining days to prayer and meditation; and, on the 24th of May, he calmly and gently fell "asleep in Jesus." His death plunged the city of Geneva into the deepest affliction; for in him they lost their most illustrious citizen, their ablest pastor, their most learned teacher, and their most valuable friend. He was buried in a common cemetery, without any extraordinary parade. His funeral was attended by almost the whole inhabitants. In compliance with his own request, there was no monument erected to his memory. But his memory is embalmed in the hearts of all the friends of learning, liberty, and religion, and will descend, with unfading honour, to the latest generations. No man has perhaps ever received so many, or such high encomiums, from writers of every age, of every country, and of every denomination. Although he had his failings, which were chiefly those of a dogmatical and irritable temper, the general and just opinion of him is, that he was "a man whose extensive genius, flowing eloquence, immense learning, extraordinary penetration, indefatigable industry, and fervent piety, placed him at the head of all the reformers." Even the language of Scaliger, usually so parsimonious in praise, is scarcely too strong, when he says, that Calvin was the most exalted character that had appeared since the days of the apostles; and that, at the age of twenty-two, he was the most learned man in Europe. Such eulogiums, from such men, should make those sciolists of the present day ashamed, who never mention the name of Calvin without a sneer, and who associate with it no ideas, but those of bigotry, intolerance, and fanaticism.

The works of Calvin are extremely voluminous. The most considerable part of them are his Commentaries on Sacred Scripture. These, which extend to the whole Bible, except the Book of Revelation, are distinguished by piety, sound sense, clear illustration, and uncommon impartiality. Of his great work, on the *Institution of the Christian Religion*, an account has already been given. Most of his productions, indeed, are worthy of perusal. For even where the subject is of a local or occasional nature, he seldom fails to edify the reader by general truths, or to please him by acute reasoning. His controversial pieces are ingenious and powerful, but frequently disfigured by intemperance and coarseness of language. His Epistles are interesting and instructive, and should be read by those who would become acquainted with the history of that period. See Bayle's *Dictionary*, art. Calvin; Beza in *Vit. Calvin*; Sennebier, *Hist. Liter. de Geneve*; *Calv. Epist*; Spon. *Hist. de Geneve*; Drelincourt's *Defence de Calvin*; Keate's *Short Account of the Anc. Hist., Present Govern., and Laws of the Rep. of Geneva*; Morus' *Panegyr. de Jean Calvin.*; and *App. to Bishop Horsley's Serm. before the House of Lords in* 1793. (*T*)

CALVINISM, that system of religious doctrine which was taught by John Calvin, the reformer, and by which he was distinguished from other Christian divines. This definition of the term, indeed, is by no means correct, according to the controversial language of the day. For we find, in the writings even of men who appear to be learned, and profess to be accurate, certain tenets condemned under the title of Calvinistic, of which Arminius himself declared his most decided approbation; and certain tenets brought forward under the same title, for which not a single authority can be produced from the publications of Calvin, or of any one of his disciples. Of this there is a remarkable example, in a work lately published against Calvinism, by the present Bishop of Lincoln. In that work, which was applauded by many before they had read it, and which has become the text book of all the Pelagian and merciful doctors of the church of England, the author takes it upon him to make the doctrine of justification by faith a peculiarity of Calvinism, and to assert, that the Calvinists hold man to be so corrupted and depraved, as to be "absolutely incapable of amendment!" When the most eminent dignitaries of the church are guilty of such misrepresentation, it is not to be expected, that authors of a subordinate rank can be very free from similar errors. Several reasons may be assigned for this misrepresentation. It may be owing to *ignorance*. It is not uncommon for controversialists, even of a superior order, to take their ideas of the subject of dispute, not from the correct and legitimate sources of information, but from those vague and distorted accounts of it, which have been adopted without inquiry, and circulated without reflection. They cannot know it by intuition; and they will not take the trouble to make themselves acquainted with it by the ordinary process of reading and investigation. Hence we find very dogmatical language held respecting the tenets of Calvin, by persons who never read a page of Calvin's works, and who either have not been able to quote him at all, or have quoted him only through the medium of others. In this way, erroneous views of Calvinism are propagated, till, according to the progress which takes place in such cases, the system loses some of its essential features, assumes other features which do not belong to it, and thus ceases to have the connection which it originally had with him from whom it derives its name. Another source of the misstatement to which we allude is, a *want of discrimination*. Even those who have perused Calvin's works, that they may learn his sentiments, have failed in making the acquisition correctly, because they have not observed the necessary distinctions. The Institutes, no doubt, should be resorted to for satisfaction, with respect to Calvinism. But that work is not to be considered as the system itself, but only as containing the system. It is a treatise of a general nature, intended by its author to give a complete view of the doctrines of the reformed churches, and to vindicate these from some unfounded aspersions, thrown upon them by the adversaries of Protestantism. It exhibits, no doubt, the peculiar sentiments of Calvin; but it also exhibits sentiments which were common to all the reformers, and which, therefore, have no title to be denominated Calvinistic. Had this fact been attended to, we should not have found, as we actually find in some works of celebrity, the doctrine of justification by faith only included under the scheme of Calvin: for it has no more connection with that scheme than infant baptism, or the divinity of Christ, or the unlawfulness of image worship, or any other doctrine which is generally received among Protestants; and it has no more connection with the scheme of Calvin, than it has with the scheme of Arminius, as may be seen by reference to the works of that divine. (See Arminianism.)—A third cause of misrepresentation in this case is, that *partial assumption of Calvinism* with which some very respectable divines are chargeable. They agree with Calvin in the greatest number of his peculiarities; but there are certain of these to which they have insuperable objections. Although, therefore, they are only Calvinists in part, they yet take the name absolutely, as if they were Calvinists in whole. When the shades of difference are few and slight, or when it is not to lead to any important consequences, such indefinite language may be allowed, because, in such instances, it will be harmless. But when material points are excluded, and when this goes to affect the merits and reputation of the system, a more precise nomenclature is necessary. Those who admit the doctrines of original sin and absolute election, as they were taught by Calvin, but reject his doctrines of particular redemption, and final perseverance, most certainly have no right to take their distinctive appellation from him. And those who are attached to his creed, nearly or wholly, as it exists in his Institutes, will consider it as unfair and injurious, because it takes away very much from the uniformity and consistency of the scheme; and consequently, in some measure, deprives it of that claim which it otherwise has to the regard of a philosophic mind. The persons of whom we speak are assuredly not Calvinists, whatever they may be. Perhaps they may with propriety be called Semi-Calvinists. Such a designation is more consistent with truth, and it is more agreeable to theological analogy. A fourth cause of misrepresentation is to be sought for in *a desire to hunt down some particular doctrine, by making it to constitute a part of Calvinism.* Calvinism is known to be obnoxious to many;—so obnoxious to them, indeed, that the very mention of it fills their minds with abhorrence; and every thing that stands connected with it is by this mere association brought into disrepute. If an uncandid man, therefore, wishes to direct the prejudice of such people against any dogma that he might otherwise find it difficult to disprove, he has only to put upon it the name of Calvinism, and immediately it receives a blow, from the effects of which no argument can possibly save it. In proof of this, we may notice the doctrine respecting justification, already alluded to, held by all the leading reformers, and by the genuine Arminians too, as well as by Calvin. It is much disliked by the Pelagians, who form a more numerous class of divines in the present day than is commonly imagined. And that it may be equally disliked by all Anti-Calvinists, they continually, in defiance of the plainest fact, and in contempt of repeated remonstrances, represent and treat it as an essential doctrine of Calvinism, by which means an odium is attached to it in the estimation of hundreds, to whom it would be quite acceptable in different circumstances. We do not say, that Calvinism is injured by this proceeding; but whatever Calvinism is, and however it may be esteemed, it should certainly, as a peculiar system, be kept free from any foreign admixture; and more especially when that admixture is violently forced into its composition from unjustifiable motives. And this remark is made, more for the sake of the doctrine in question, than for Calvinism itself, because, though both may be true, the former is unquestionably of the greatest moment; and in relation to this, the cautionary language of Dr Horsley ought ever to be attended to: "Take special care," said he in his last charge, "before you aim your shafts at Calvinism, that you know what is Calvinism, and what is not; that in that mass of doctrine, which it is of late become the fashion to abuse, under the name of Calvinism, you can distinguish with certainty between that part, which is nothing better than Calvinism, and that which belongs to our common Christianity, and the faith of the reformed churches." Calvinism has been misrepresented in another way, by some who can scarcely be suspected of ignorance. Determined to bring it into discredit, at whatever rate, and finding that in its genuine form it recommends itself too much to a sound understanding, they *attach to it certain positions of which nobody can approve*; hold out these as essential parts of the system; and thus, as the one cannot well be received without the other, furnish a pretext for rejecting the whole. Thus they represent Calvin and Calvinists as teaching, that man is laid under the natural necessity of sinning; that he cannot resist divine grace; that he is utterly incapable of moral exertion; and many other things, equally repugnant to Calvinism, to scripture, and to common sense. Instances of this are to be found in the writings of most anti-calvinists. And in connection with such reprehensible unfairness and injustice, is the common practice of charging upon Calvinism consequences which are not merely disavowed by its abettors, but which are not realized in fact, and which may, with as much reason at least, be charged upon the several systems of its opponents. It has been reprobated, for example, as derogatory to the perfections and character of God, and as injurious to the interests of practical morality among those who embrace it; and yet it is a notorious and undeniable fact, that wherever the doctrine and discipline of Calvin have existed, and been allowed to operate, the people have been remarkable for an enlightened piety, and the strictness of their moral conduct. Indeed, one common objection urged against Calvinism by its enemies, is, that it renders its votaries too pious and too strict for this world as it is now constituted.

We have made these observations, on the supposition that the reader is in some measure acquainted with the tenets of Calvin. In this article, it is not our intention to enter particularly into the statement or illustration of these tenets; but under the word Election, we shall take the opportunity of giving a concise and accurate view of them: and, in the mean time, those, who wish to have the fullest information on the subject, must have recourse to the writings of Calvin, and especially his *Institution of the Christian Religion*, and not to the false and superficial glosses of his adversaries; which, as we have endeavoured to shew, are unsafe guides in such an investigation.

A history of Calvinism would be interesting and useful; but our limits do not admit of it even in the most succinct way in which it could, with any propriety, be written. Under the article Confession of Faith, it will be seen how far the doctrines of that system have been received by the several communities and assemblies of the Christian church. It is to be observed, however, that many sects, who have no public confession of faith, have adopted and maintained most firmly the leading peculiarities of Calvinism. (*τ*)

CALYCANTHEMÆ. See Botany, p. 72.

CALYCANTHUS, a genus of plants of the class Icosandria, and order Polygynia. See Botany, p. 227.

CALYCERA, a genus of plants of the class Syngenesia, and order Polygamia Segregata. See Botany, p. 304.

CALYMENIA, a genus of plants of the class Triandria, and order Monogynia. See Botany, p. 105.

CALYPLECTUS, a genus of plants of the class Icosandria, and order Monogynia. See Botany, p. 227.

CALYPTRA. See Botany, p. 42.

CALYPTRANTHES, a genus of plants of the class Icosandria, and order Monogynia. See Botany, p. 223.

CALYSTEGIA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 167; and Brown's *Prodromus Plant. Nov. Holl.* &c. p. 483.

CALYTRIPLEX, a genus of plants of the class Didynamia, and order Angiospermia. See Botany, p. 252.

CALYX. See Botany, p. 40.

CAMARAN, or Kamaran, an island in the Red Sea, lying between Loheia and Cape Israel, on the Arabian coast. It stretches in the direction of north east and south west, and is about 16 miles long and 7 broad, and only two miles distant from Cape Israel. Large vessels can anchor with security in a bay on the eastern part of the island. There is a white house or fortress, containing some soldiers and cannon, on the west end of the island, and it furnishes good water, together with goats and fish, to any ships that touch there. This island is one of the most fertile and agreeable in the whole Arabian Gulf. Great quantities of white coral, fish, and pearl oysters, are obtained on the coast. Salt is also made here, and a considerable number of cattle are reared. The islanders carry to the coast of Arabia, the dates, sugar, and millet, which are produced on the island. N. Lat. of the northern point 15° 31½′, N. Lat. of the southern point 15° 18′, E. Long. of the centre of the island 42° 40′. See Ovington's *Voyage to Surat*, and the Chart of the Red Sea in Lord Valentia's *Travels*, vol. ii. (*o*)

CAMAX, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 139.

CAMBAY, probably the *Camanes* of Ptolemy, is a city of Hindostan, in Guzerat, situated about a league from the gulf of the same name, upon the north bank of the river Canari, Catari, or Myhic. This city is enclosed with a strong wall, about five miles in circuit, in which there are 12 gates. The streets, which are very large, have separate gates at the entrance of each, and these are shut every night. The houses, which are well built, are chiefly of stone, brick, or marble; and the principal edifices of a public nature, are the three bazars, and four cisterns, by which the town is copiously supplied with water in dry seasons.

The sea formerly flowed to the city of Cambay, and formed a commodious harbour, but it is now fully half a league from the town, and large vessels cannot approach nearer to it than within three or four leagues. This cause, together with the violence of the tides, which move with immense velocity, and the numerous rocks in the Gulf of Cambay, have contributed to the decline of its commerce.

Cambay was formerly one of the largest and richest cities of the East. It was called the *Cairo* of the Indies, on account of the extent of its commerce, and the fertility of its soil, which produced cotton, opium, indigo, and many other valuable articles of trade; but though its commerce has suffered a great diminution, it is still very considerable. The natives of the country, particularly the Benjans, who devote themselves to commercial pursuits, and who have a perfect knowledge of precious stones, carry on a very extensive trade with Diu, Goa, Cochin, Acheen, Bantam, Batavia, Bengal, the coast of Coromandel, Persia, and the Red Sea. As the Benjans, however, were unexperienced sailors, their vessels were always managed by Dutch pilots, whom they hired at a very high rate from the Company. This city was frequented by merchant vessels from every part of the East Indies, from Mozambique, Melinda, and from the Arabian and Persian gulfs.

The principal articles exported from the country were fine cotton cloths, canvass for the sails of ships, silk stuffs of various kinds, scarfs for ladies headdresses, carpets, bed covers of silk and cotton, mattresses, indigo, saltpetre, borax, cummin, ginger, rhubarb, sugar, oil, butter, elephants teeth, and numerous precious stones, which are found in Guzerat. Great quantities of grain and fruits of different kinds were also shipped at Cambay for different parts of the East. East Long. 72° 36′, North Lat. 22° 17′. (*o*)

CAMBOGE, Cambova, Camboja, Cambodia, the different names of a country in Asia, which now forms a part of the empire of Tunkin. Camboge commences a little above the 9th degree of north latitude, and terminates at the 12th. It is bounded on the east by Cochinchina and Tsiampa, Ciampa, or Champa, on the west by the kingdom of Siam, on the north by Laos, and on the south by Cochinchina. A perpendicular chain of mountains, running from north to south, separates Camboge, Lac-tho, and Laos, from Cochinchina and Tunkin; and another chain of mountains, having nearly the same direction, separates these three states from Siam and China. This chain descends as it approaches the south, and terminates at Cape Camboge, the most southern part of the empire of Tunkin. The river Camboge, called Mecon, or Maykaung, near its mouth, and by some the Japanese river, takes its origin in this country. It waters Lower Cochinchina, and after passing by its capital, it throws itself into the Chinese Sea on the south south east. This river is one of the largest and finest in the country. At a great distance from the sea, it is about two miles broad, and is always so deep that the largest vessels may navigate it about 20 miles up the country.[*] At its embouchure, there are several sand banks and low islands, which impede the navigation, but these may be easily avoided. This river begins to inundate the country in June, and it is said to have a depth of four fathoms at its mouth. At the distance of five or six miles from the shore, the depth of the sea was seldom greater than four fathoms, and no vessel larger than a boat could approach within less than two miles of the coast.

The soil of Camboge is extremely fertile, but its cultivation has been greatly neglected. It produces abundance of corn, rice, legumes, sugar, indigo, opium, camphire, and various medicinal plants, whose names and properties are not well known, but which abound more in Camboge than in any of the adjacent states. The point of Camboge, and the whole coast stretching from it to the western branch of the river, is exceedingly low, and is covered with underwood. The articles of trade exported from this country, when it was visited by Bowyear in 1696, were Camboge gum, benjamin, cardamoms, wax, lack heckarie, cayalaca, and Japan wood; damer, buffaloes hides, deer skins, and nerves; elephant's teeth, rhinoceros's horns. A considerable quantity of gold is found in the neighbourhood of Namnoy, a village situated at the extremity of the country, a few days journey from the frontiers of Laos; and amethysts, hyacinths, rubies, topazes, and other precious stones, are found in different parts of Camboge. The following passage from Mr Bowyear's journal, lately published by Mr Dalrymple, contains some additional information respecting this interesting country. "Here I also met the ambassador of Camboja, who complained of the usage and trouble the Cochinchinese gave to foreigners, and promised better treatment in his country, where the trade is free of imposition and customs; a correspondence here with the Laws, probably may be a way to dispose of some quantity of our broad cloth. This country is said to be rich in mines of gold and silver, as well as iron and steel, which comes behind none; such plenty of timber of all sorts, that the Spaniards from Manilla have sent hither to build their galleons. The woods abound with rhinoceroses, elephants, deer, buffaloes, wild hogs, &c. They have rice, and all sorts of provisions, in great abundance. The people are given up to superstition and ease."

The Portuguese for a long time engrossed the whole trade of this country; but it was afterwards opened, and an extensive trade carried on with the English, Dutch, Chinese, Japanese, Siamese, Cochinchinese, and Malays. The Dutch and Portuguese sent cloths of various kinds from Malacca, and exchanged them for the productions of Camboge. The Chinese, however, carried on the greatest trade, as will appear from the following tables.

Goods exported from Camboge into Canton, in the year 1767, by two junks.

	Peculs.	*Catty.*
Bark of a bastard sort of rosewood, for dyeing - - - -	16	84
Betel nut - - - - -	844	15
Beecha de Mar, or sea slugs - -	292	25
Black wood - - - - - -	939	62
Cardamoms - - - - - -	9	19
Nutmegs - - - - - -	5	55
Cotton - - - - - -	58	49
Dried sea snails - - - -	55	11
Dried fish - - - - -	215	88
Medicinal drugs - - - -	133	33
Round flat drug, like a stone, used in medicine - - - - -	185	63
Elephants teeth - - - -	10	79
Gamboge - - - - -	6	43
Long pepper - - - -	4	72
Mother-of-pearl shells - - -	281	02
Pepper - - - - - - -	50	50
Bastard sort of rosewood - -	1.783	53
Incense wood, like rosewood - -	8	42
Sago - - - - - - -	12	27
Japan wood - - - - - -	2.222	88
Deer skins - - - - - -	7	08
Tin - - - - - - -	19	23
Tortoise-shell - - - -	5	21
Wax - - - - - - -	36	39

Goods exported from Canton into Camboge, in 1767, in one junk.

	Peculs.	*Catty.*
Congo tea - - - - -	8	04
Dried fruits, leechees, and long yeans	6	57
Drugs - - - - - - -	0	09
China plants and figs - - -	33	03
China plants of another kind - -	1	38
Lackered ware - - - -	4	23
Paper kites for children - -	10	15
Sticks long and thin, with a mixture of sand and wood, burnt to the dead and to idols - - - - -	139	47
Preserved oranges - - -	0	54
Tinned paper - - - -	4	16
Tutenague - - - - -	1.014	89

The inhabitants of Camboge are Chinese, Japanese, and Malays, who have intermarried with the natives. The men have long black hair, and a dark yellow complexion: they are well made, and wear a long loose robe. This robe is fastened to one foot, and is coiled round the body till it covers the whole of it up to the neck. It descends again on the other side, and leaves nothing uncovered but the feet and legs. The women, who are handsome, but not modest, wear the same dress, and are distinguished from the men by the form of their bodies, and by their having no beard. The Malay language is generally understood by all the people in this country.

In this state there are four communes which bear the name of towns. Camboge, the capital, is situated upon the river of the same name, which is navigable up to the town by large vessels, and a considerable way beyond it by vessels of a smaller size. The town consists of one street; and at a small distances are seen the ruins of an ancient city built of stone, of an architecture resembling the European. The temple of Camboge has been much admired. It stands on wooden pillars varnished with black. The foliages and reliefs are gilt;

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[*] "A considerable way up the river a cataract is laid down by some maps, which, if correct, must be an interruption to the navigation upwards. However, I do not find any authentic account of this fall, nor indeed any at all of its height, so that it is impossible to say whether it will be a hindrance at all seasons, or only when the waters are low."—Dalrymple's *Oriental Repertory*, vol. i. p. 67.

and the pavement, which is kept covered with mats, is very valuable and curious. The population of Camboge, since a part of it has been added to Cochinchina, is 1,000,000. For a very full account of the statistics, &c. of this country, we must refer the reader to the article Tunkin, which will contain a very copious account of that extensive empire. See *Historia de las Islas del Archipelago y regnes de la gran China, Tartaria, Cochinchina, Malacca, Siam, Camboya, Japan, &c.* par Fr. Marcello de Ribadeneyra; Barcelone, 1601. Fernand. Mendez Pinto *Peregrinaçam, em que da conta de muytas e muyto estranhas chusas, que vio e orvia no regno da China, no du Tartaria, no du Sornan, &c. &c.*; Lisbonne, 1614. Gabriel de S. Antonio, *Breve e vererdera Relacion de los successos del regno de Camboxa*; Valladolid, 1614. The *History of an Englishman who was shipwrecked on the Coast of Camboge*; Lond. 1612. *Relation des Missions et des Voyages des Eveques Français envoyés aux royaume de Siam, de la Cochinchine, de Camboge, et de Tunkin*, par Francois Palla; Paris, 1699. See also Staunton's *Embassy to China*, vol. i. p. 320; Dalrymple's *Oriental Repertory*, vol. i. p. 67, 88, 281, &c.; and *Exposè Statistique du Tunkin de la Cochinchine, du Camboge, du Tsiampa, du Laos, du Lac-tho, par M. M. N. sur la Relation de M.* de la Bissachere, Missionaire dans le Tunkin, vol. i. and ii. passim. Lond. 1811. (π)

CAMBRAY, the *Camaracum*, or *Camaracum Nerviorum*, of the ancients, a city of France, and the principal place of a district in the department of the North, is situated on the banks of the Scheldt, by which it is divided into two parts. The city is large, well built, neat and clean, and every where exhibits the remains of wealth and prosperity. Though the town is irregular, and the suburbs mean, yet the streets are spacious, and the public buildings magnificent. The houses are all built in the Spanish fashion, with their gable ends towards the street. The place or square for arms is so large as to contain the whole garrison in order of battle; and, though irregular, it has a fine effect. The principal hotel and the Episcopal palace are superb edifices; and the pyramidal steeple of the cathedral has been much admired, though it is still inferior to the steeples at Vienna, Strasburg, and Antwerp. There are more than 600 steps from the ground to the foot of the spire, which receives no support either from carpentry or iron-work, and which appears to be as high as the rest of the building. Exclusive of the cathedral, there are two collegiate churches and eight parish churches, together with several abbeys and hospitals. Cambray is well fortified, being defended by a fort, and by a strong though ancient citadel; and, as the adjacent country may be inundated, it is reckoned one of the strongest cities of the Netherlands.

Cambray was formerly one of the most celebrated cities in Europe for its manufacture of fine stuffs; and its commerce, favoured by the Scheldt, which is however scarcely navigable up to the town, contributed to enrich its inhabitants. Since the establishment of similar manufactures at St Quintin and Valenciennes, those of Cambray have sustained a very considerable diminution. The manufactures carried on at present (1812) in Cambray, are those of linen, cambric, lace, black soap, tapestries, hosiery; and there is also a very extensive bleaching establishment, and a refinery of salt. In the year 1779, there were manufactured at Cambray, 977 pieces of lawn ⅔ds wide; 77 pieces of lawn ¾ths wide; 7578 pieces of cambric; 171 pieces of striped lawn; and 6 pieces of lawn wrought with gold, silver, &c.; and about 10,000 pieces of cloth were bleached during the same year. Fairs, which continue for nine days, and at which all sorts of merchandise are sold, are held on the 25th of April and the 28th of October. Population 15,600. East Long. 3° 13′ 41″, North Lat. 50° 10′ 32″. See Bygge's *Travels*, p. 55, 56; and Tynna's *Almanach du Commerce*, 1811, p. 755. (*o*)

CAMBRIA. See Wales.

CAMBRIC, one of the finest and most dense species of the cloth manufacture. The French cambric, although its importation into this country be prohibited by law, is held in the greatest estimation. Cambrics, in imitation of the French, are also manufactured in Ireland; and the encouragement of this manufacture, along with other political causes, probably induced the legislature to impose the prohibition. The cambric used, which is the measure of fineness in every species of cloth, is calculated upon a different scale from those used in the linen manufactures of this country and Ireland. The Scotch and Irish reeds are computed according to the number of hundreds of splits or divisions which they contain in 37 inches, that being the measure of the Scotch ell; the Dutch reeds for Holland cloth, are reckoned by the number contained in 40 inches; and the French cambric reed by the number contained in 34 inches. In Lancashire and Cheshire, the mode of computation is entirely different; and even those counties, although contiguous, differ as much from each other as they do from the Scotch, the Dutch, and the French. The small table annexed to this article, exhibits a comparative view of the Scottish linen, with the French cambric reed, by using which, the one standard may be reduced to its nearest equivalent measure on the other at a single glance. The city of Cambray, and the adjacent districts of what were formerly denominated the French Netherlands, were formerly the seat of this manufacture. How far it has suffered by the vicissitudes of revolution and the calamities of war, we have no accurate means of ascertaining. The texture of cambric being remarkable, both for its fineness and its closeness, the excellence of the manufacture must depend in a much greater degree upon the quality of the raw material, than upon the skill or dexterity of the artizan; and rich as the soil of Ireland is acknowledged to be, this single cause presents a physical obstruction to their rivalling the French in this species of manufacture, unsurmountable by any invention which human ingenuity can devise, or by any exertion of labour which human industry can produce. Where nature has denied the requisites, industry may be misdirected and ingenuity misapplied; but the object never will or can be attained. In the operation of weaving, there is nothing particular. It is merely very fine plain cloth, of a stout fabric, and is now very successfully imitated in cotton, although the softness of the cotton fibres will render it impossible that it should ever rival the flax in that glossy smoothness for which it is chiefly admired. From these circumstances, it seems in vain to expect that the cambric manufacture can ever be attempted, with any rational probability of success, in any part of the British dominions.

Comparative Table of Cambric, Linen, and Holland Reeds, exhibiting at one view the ratio which they bear to each other respectively.

Cambric Reed	Linen Reed.	Holland Reed.	Cambric Reed.	Linen Reed.	Holland Reed.
1378	1500	1622	1930	2100	2270
1470	1600	1730	2022	2200	2378
1562	1700	1838	2114	2300	2486
1654	1800	1946	2206	2400	2594
1746	1900	2054	2298	2500	2702
1838	2000	2162	2390	2600	2810

EXPLANATION.

The measure of the cambric reed is the number of divisions contained in 34 inches; that of the linen reed in 37 inches; and that of the holland reed in 40 inches. The linen reed is therefore counted by hundreds, as is the practice in this country; and in the respective columns for the cambric and holland, are placed the numbers of their reeds, which would exactly correspond in fineness with each linen reed, and consequently with each other. Thus, in the first line, a cambric reed of 1378 divisions is equal in fineness to a linen reed of 1500 divisions, and also to a holland reed of 1622 divisions.

Ninety-two divisions on the cambric scale correspond with 100 on the linen and 108 on the holland scale.

The finer kinds may be found by the common rule of simple proportion, as 37 is to 34, so is the linen reed to the cambric. In the bleaching and dressing of cambrics, much of their marketable appearance consists. In those bleaching grounds or fields where this branch of the business is carried on, it is necessary, in order that it may be properly done, to use a considerable variety of machinery applicable to the particular purpose, but of which the minute description does not properly belong to this article. (J. D.)

CAMBRIDGE, the seat of a celebrated university, and capital of a county of the same name, is situated on the banks of the river Cam, and is supposed to be the *Granta* of the Romans. Many absurd traditions have been circulated concerning the origin of this city, which have afforded a fruitful theme of disputation to the antiquaries of the sister universities. But though much has been written upon this subject, little is yet known with any degree of certainty. Some have even referred the foundation of this university to the 375th year before the Christian era, and have not scrupled to affirm that Anaximander and Anaxagoras were teachers of philosophy at Cambridge! Be this as it may, of the great antiquity of this city there can be no dispute. It holds a distinguished place under the name of *Caergrant*, in the lists of the British cities given by Gildas and Nennius; and numerous traces of Roman labour and civilization point it out as a station once belonging to that people. Ancient roads diverge from this place to Ely, Haverill, Ashwell, and Godmanchester; and various fragments of urns, as well as many Roman coins of Vespasian and his successors, have been found in the adjoining fields. Dr Mason, in a manuscript quoted by Mr Gough, observes, that "in a gravel-pit, near a rill of water, called the Vicar's Brook, many curious *pateræ* of fine red earth were found, one large vase three feet long, brass *lagenæ*, a brass dish embossed, the handle of a sacrificing-knife, the brasses of a *pugillaris*, or table book, some large bones, and Roman coins, now in Trinity college."

The ancient town is supposed to have been much superior to the modern Cambridge, both in extent and population; and is said to have reached from the castle of Grantchester on the south, to the castle of Chesterton on the north, about three miles along the western bank of the river. At present, it is only about a mile in length, and half a mile in breadth, being nearly of an oval form, diminishing towards each extremity. The principal streets are, Bridge-street, which, crossing the river by a stone bridge of one arch, extends the whole length of the town, and, at its south-east end, takes the name of St Andrew's-street; and Trumpington-street, through which is the entrance from London, and which, near its junction with Bridge-street, is called St John's lane. These streets, however, are not uniform in breadth, but in many places are narrow and crooked; and the houses are in general old, ill-built, and crowded closely together. The best houses are in the market-place and the contiguous streets; but, though this town cannot boast of much elegance in its appearance, it possesses both convenience and neatness, and contains some of the finest buildings in the kingdom.

The *church of St Sepulchre*, usually called the *Round Church*, or, as it was originally named, "the church of the Holy Sepulchre in the Jewry," affords a curious specimen of ancient architecture, and is supposed to have been erected by the Knights Templars, or by some persons concerned with the Crusades, in the reign of Henry the First.[*] It was built after the model of the church of the Resurrection, or Holy Sepulchre at Jerusalem, in the Saxon style of architecture; and, in its primary form, was completely round, with a peristyle in the interior, of eight circular pillars, supporting a conical roof. The semicircular arch over the west door, is ornamented with round zig-zag mouldings, which spring from Saxon capitals. It has, however, been much disfigured by subsequent alterations, and, in its present state, appears under many disadvantages. "It is evidently," says Mr Essex, a story higher than its original architect intended it should be. This alteration was made in the reign of Edward II. for the reception of bells, when the windows were also altered, the chancel added, and the ornaments about the door defaced, and partly hidden by a wooden portal."

Great St Mary's, or the *University Church*, which stands in the middle of the town opposite the Senate-house, is built in the Gothic style, and has a lofty tower crowned with four elegant pinnacles, but is remarkable neither for its beauty nor uniformity of architecture. It is about 120 feet long, and 68 broad, and consists of a nave, a chancel, and side aisles. Here the members of the university generally attend divine service on Sundays and holidays. A handsome gallery raised between the nave and chancel, contains the seats of the vice-chancellor, heads of colleges, noblemen, and doctors. The proctors, masters of arts, fellow-commoners, &c. are accommodated in the lower part of the church; and the bachelors and under graduates sit in the galleries over the side aisles. This church was erected by voluntary contribution in 1478; but was not finished till more than a century afterwards, in 1608. Besides these, there are eleven other parish churches in Cambridge, but none of them are deserving of particular observation.

The most elegant buildings of this city belong to the university, consisting of twelve colleges and four halls, each of which contains apartments for the students and fellows, and has a master's lodge, a chapel, a library, a hall, and a combination-room. Before, however, we proceed to give a description of these buildings, we may premise, that, previous to the erection of colleges, the students lodged in hotels or inns kept by the inhabitants, and defrayed out of their own pocket all charges for maintenance and education; and it was on account of the exhorbitant demands to which they were exposed from the landlords of these inns, and to relieve them from such exactions, that colleges were founded for their accommodation and support. The most ancient of them is,

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[*] Essex's Archæologia, vol. vi.

St Peter's College, or *Peter-house*, which stands on the west side of Trumpington street, and consists of two courts, separated from each other by a cloister and gallery. This college was originally formed of two hotels, which Hugh de Balsham, sub-prior of Ely, in 1257, purchased and appropriated to the use of the students, and afterwards endowed for the support of a master, fourteen fellows, and eight scholars. Since that time, however, its revenues have been considerably augmented by numerous benefactions, and its fellowships and scholarships proportionally increased. It is reported, that when Lady Mary Ramsey offered a very large property to this college, upon condition that its name should be changed into "Peter and Mary's," Dr Soame, the master, replied, with rather sarcastic humour, "Peter has been too long a bachelor, to think of a female comrade in his old age;"—"a dear-bought jest," says Fuller, for so good a benefactress; for Lady Ramsey, disgusted at his refusal, turned the stream of her benevolence into a different cnannel." The chapel of this college is a handsome structure, with embrazures and pinnacles; and over the altar-piece is a beautiful window of painted glass, representing the Crucifixion. In some parts it is very richly coloured, and the figures, which are copied from the famous picture of Rubens on the same subject at Antwerp, are nearly as large as life.

Clare Hall, when founded by Dr Richard Badew, the chancellor, in 1326, was called University Hall; but having been destroyed by fire about sixteen years after, it was rebuilt under its present name by Elizabeth de Burgh, third daughter and heiress to the last Earl of Clare, who endowed it with lands for the maintenance of a master, ten fellows, and as many scholars. In 1638, however, the whole college was renewed by subscription, and is now one of the neatest and most uniform buildings in Cambridge. It is delightfully situated on the eastern bank of the Cam, and consists of one spacious court, which is entered on the east and west sides by two lofty arched passages. Each of its fronts are elegant; but that which looks towards the river is magnificent, being built of Ketton stone, and ornamented with two ranges of pilasters, of the Tuscan and Ionic orders. The middle tier of windows is adorned with pediments, and the other two with architraves, and the whole is finished with a circular pediment, decorated with urns, an entablature, and handsome balustrade. The chapel, which was erected in 1703, from a classical design by Sir James Burroughs, and which cost above 7000*l.*, is allowed to surpass, in chasteness and elegance of decoration, every building of the kind in the university. Over the altar is a beautiful alcove, in which is a fine painting of the Salutation, by Cipriani.

Pembroke Hall, which stands nearly opposite to Peter-House, on the east side of Trumpington street, was founded in 1343, by Mary, Countess of Pembroke. Her husband having been killed at a tilting-match on her wedding-day, this lady resolved to renounce the world, and to devote her immense possessions to acts of benevolence. Having accordingly obtained a charter of incorporation from Edward III., she endowed this college for a master and six fellows; but its establishment was greatly increased by succeeding benefactors, and particularly by Henry VI., who bestowed upon it the rich living of Soham and other rectories. This building contains two courts, which are separated by the hall, but they are both ancient, and make but a mean appearance. In a small detached brick building, which stands in the inner court, is contained a curious astronomical hollow sphere, presented to the college by Dr Roger Long, and invented and partly constructed by himself. It is about eighteen feet in diameter; it can conveniently accommodate above thirty persons sitting within it, and the whole can be turned round by a small winch, with the greatest facility, though its weight is above one thousand pounds. This machine, however, though the Doctor left the interest of 200*l.* bank annuities to keep the instrument and place in good repair, is now much damaged, and is fast falling into decay.[*]

Corpus Christi, or *Bene't College*, was originally called "Corpus Christi and the blessed Virgin Mary," from the name of two religious societies, at whose joint expence it was at first established, and received the name of St Benedict or Bene't, merely from its vicinity to the church dedicated to that saint. It was begun in 1344, but was not finally endowed until 1356, when it received a master, eight fellows, three bible-clerks, and six scholars. This edifice is now much decayed, and it is intended to rebuild it upon a new and elegant plan, which is already designed, and shewn for inspection. A legacy of 1000*l.* left by Dr Thomas Herring, archbishop of Canterbury, and a still larger one by Dr Mathias Mawson, master of the college, and bishop of Ely, are appropriated to that purpose. The library of this college contains a collection of very rare and valuable manuscripts, chiefly relating to ecclesiastical affairs. It was left by Archbishop Parker, with this particular restriction, that if at any time twenty-five books are missing, and cannot be found in six months, the whole devolves by rotation upon Caius College and Trinity Hall, who, however, retain them only upon the same condition. This library is consequently kept with great care, and is annually visited and examined by the masters of these colleges.

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[*] The following description of this ingenious piece of workmanship is contained in the second volume of Long's Treatise on Astronomy: "This sphere is eighteen feet in diameter, wherein thirty persons may sit conveniently. The entrance into it is over the south pole by six steps. The frame of the sphere consists of a number of iron meridians, not complete semicircles, the northern ends of which are screwed to a large round plate of brass, with a hole in the centre of it. Through this hole, from a beam in the ceiling, comes the north pole, a round iron rod, about three inches long, and supports the upper part of the sphere to its proper elevation to the latitude of Cambridge; the lower part of the sphere, so much of it as is invisible in England, is cut off; and the lower or southern ends of the meridians, or truncated semicircles, terminate on, and are screwed down to, a strong circle of oak, of about thirteen feet diameter, which, when the sphere is put into motion, runs upon large rollers of lignum vitæ, in the manner that the tops of some windmills are made to turn round. Upon the iron meridians is fixed a zodiac of tin painted blue, whereon the ecliptic and heliocentric orbits of the planets are drawn, and the constellations and stars traced. The Great and Little Bear, and Draco, are already painted in their places round the north pole; the rest of the constellations are proposed to follow. The whole is turned round with a small winch, with as little labour as it takes to wind up a jack, though the weight of the iron, tin and wooden circle is above one thousand pounds. When it is made use of, a planetarium will be placed in the middle thereof. The whole, with the floor, is well supported by a frame of large timber."

Gonvile and Caius College, or, as it is usually called, Key's College, was originally founded in 1348 by Edmund Gonvile, near the gardens of St Bene't's; but this gentleman dying soon after it was begun, left a sum of money at the disposal of Bishop Bateman, for finishing and endowing it. The Bishop, who was then engaged with his own foundation of Trinity Hall, deferred, for a time, the completion of his friend's plan; and afterwards, having removed its site, he fixed it near his own, and endowed it with lands and tenements for a master, four fellows, and two scholars. It formerly consisted of only two courts; but, in 1557, Dr John Caius, physician to Queen Mary, built a third, and procured a charter of incorporation under its present name. He also erected an elegant gate to each court. The first, which is opposite the street, is very simple, with the inscription, "*Humilitatis*;" the second, in the middle of the college, is in a very fine style of architecture, and has on one side, the inscription "*Virtutis*," and on the other, "*Jo. Caius Posuit Sapientiæ*;" the third, which leads to the senate-house, is more ornamented, exhibiting specimens of the Doric, Ionic, and Corinthian orders, and has "*Honoris*" inscribed upon it. In the chapel is a grand tomb, erected to the memory of Dr Caius, with the following epitaph:

FUI CAIUS
VIVIT POST FUNERA VIRTUS.

Trinity-Hall, as we have already observed, owed its foundation as a college, to William Bateman, bishop of Norwich, who endowed it for a master, three fellows, and two scholars, to be students in the canon and civil law, and one fellow to study divinity. This college was originally one of the hotels for the accommodation of the students. It consists of a large court, and other buildings, and is handsomely built with stone, and uniformly sashed. Among the benefactions made to Trinity-hall, is one of 20,000*l.*, left in 1747, by Dr John Andrews, for the erection of two spacious wings, which are to extend from the present building towards the river; but the appropriation of the money to this object, awaits the decease of two maiden sisters. In the chapel is a fine painting of the "Presentation in the Temple," by Stella.

King's College owes its origin to the piety and literature of Henry VI. who in 1441 instituted a small seminary for a rector and 12 fellows, which he dedicated to the Virgin Mary and St Nicholas. About two years after, he laid the foundation of the present building, and endowed it for a provost, 70 fellows and scholars, to be supplied from Eton, 3 chaplains, 6 clerks, 16 choristers and a music master, 16 officers of the foundation, 12 servitors for the senior fellows, and six poor scholars. Had this building been finished according to its original plan, it would have equalled, if not surpassed, the most splendid palaces in Europe. But its completion was delayed by the disturbances of the state, which diverted the attention of the monarch to more important concerns, and was at last prevented by his death, and the injustice of his successor. For though Henry left bequests sufficient for the complete execution of his plan, Edward IV. deprived the college of many valuable estates, from which the expence of the building was to be defrayed. As it at present stands, however, it sufficiently evinces the munificence of its founder, and its chapel displays, perhaps the most perfect specimen of Gothic architecture now remaining in Europe. This building, so justly admired by every artist for the sublimity, elegance, and ingenuity of its construction, is 316 feet in length, and 84 in breadth. On each side are eleven immense buttresses, terminating in elegant pinnacles; and on each corner is an octangular tower, 146½ feet high, and crowned with a beautiful dome. Its open worked battlements also give an airiness and elegance to its appearance, and exhibits a fine contrast to the massive materials of which it is composed. The interior of the building is yet more striking, and its vast stone roof, unsupported by a single pillar, is an object of astonishment to every beholder. It is in the form of a Gothic arch, but somewhat flattened at the centre, and is divided into twelve parts, separated from each other by the eleven principal arches, which spring from the buttresses. Each division of the roof is formed of elegant groined arches of beautifully carved work, and in the centre is suspended a massy stone, of above a ton in weight, and finely ornamented with roses and portcullisses. The inside walls are also wholly covered with numerous sculptured ornaments of exquisite and almost inimitable workmanship. These chiefly represent the arms of the houses of York and Lancaster, with a vast number of crowns, roses, portcullisses, and fleurs de lis. Some of the supporters, though cut in stone, display the hand of a skilful master, and equal in expression and character almost any marble sculpture. On a pannel, at the upper part of the screen which separates the anti-chapel from the choir, is a small piece of sculpture, in very bold relief, representing the Almighty hurling the rebel angels from Heaven, which is universally admired; and on the altar-piece, is a fine painting of the "Taking down from the Cross," which was presented by the Earl of Carlisle, and is supposed by some connoisseurs to be a production of Raphael, though his Lordship purchased it on the continent as the work of Daniel de Volterra.

In addition, however, to the magnificence of the building, and the symmetry, elegance, and taste of its internal decorations, this chapel is also highly celebrated for the exquisite beauty of its painted windows. Of these there are twelve on each side, and one in the east end; the large west window being left plain, in order to introduce sufficient light into the chapel. The side windows are about 50 feet high, are separated by munnions into five lights, and are divided into an upper and lower compartment by a stone transom. Each window contains four paintings; and each painting fills two lights; and in the central light of each division is depicted an angel and a saint, exhibiting scrolls descriptive of the events represented in the other parts of the window. The subjects are all taken from scripture history; those in the upper compartments are in general selected from the Old Testament, and those underneath from correspondent circumstances in the New. For instance, in the fourth window from the east end, on the north side, the delineations on the upper division are,

Left side.—Elisha raising the son of the Shunamite.

Right side.—David returning from battle in triumph, with the head of Goliath. Women meeting him playing on their harps.

And on the lower division:

Left side.—Christ raising Lazarus from the dead.

Right side.—Christ riding in triumph to Jerusalem. Zaccheus mounted on a tree.

Thus, in the arrangement of the paintings, a particular order is observed throughout the whole. The subjects from the New Testament, on the north side, are all prior to the crucifixion of our Saviour; while those on the south side are posterior to that event; and the east window is devoted entirely to the most material circumstances immediately connected with that transaction. This window is 53 feet high and 28 wide, and is separated, by two elegant buttresses and a transom, into six compartments. Each compartment contains one subject, and is divided by munnions into three lights. In the lower division, from right to left, are, "Christ exposed to the People," "Pilate washing his Hands," and "Christ bearing the Cross." In the upper division, in the same order, are, "The nailing to the Cross," "The Crucifixion," and "The taking down from the Cross." But it is impossible to convey by words any idea of the excellence of composition, the discrimination of character, and the beauty of colouring which distinguish these paintings. "The strong contrast, energy, and variety of character," says a modern author; "the powerful judgment evinced in the disposition and grouping of the figures; the boldness and freedom of the penciling, mingled with a playful wildness of execution, to which the hand of a master only could be competent; the sublimity of the designs; the richness and brilliancy of the colouring, and the vigorous and characteristic justness of expression in the different figures, may well warrant the assertion, that these admirable pieces have very rarely been paralleled, and scarcely ever exceeded."

This college consists of two courts, one on each side of the chapel. The old court, which is situated on the north, between the schools and Clarehall, is 120 feet long, and 90 broad; but from its being very ancient, many of the apartments are small and inconvenient. The new court is nearly 300 feet square, and is formed by the chapel on the north, a provost's lodge on the east, and a magnificent edifice built of Portland stone on the west. On the south side, which is still empty, it is intended to erect a grand pile of building, which is to be separated from the street by a handsome colonnade.

Queen's College was founded in 1448, by Margaret of Anjou, consort of Henry VI., and was endowed for a president and four fellows. These last, however, were afterwards encreased to nineteen, besides 45 scholars, by Elizabeth, queen of Edward IV., who is annually celebrated as a co-founder. It is composed of two courts, and stands upon the east bank of the river, over which is a curious wooden bridge of one arch, supported by abutments of rustic stone work.

Catherine Hall was founded in 1475, by Robert Woodlark, chancellor of the university, who appointed a master and three fellows, and dedicated it to St Catherine. It consists of one large quadrangular court, open towards the street, from which it is separated by an iron pallisade, and a piece of ground planted with elms. Its west front, opposite Queen's College, is adorned with a handsome portico.

Jesus' College stands at the north-east end of the town, upon the site of an ancient Benedictine nunnery, which was dissolved by Henry VII., and its possessions granted to John Alcock, bishop of Ely, who, in 1497, converted it into a college for a master, six fellows, and six scholars. It has two courts, and its principal front is 18 feet in length, elegantly built and sashed, with a handsome tower gateway at the entrance. In the chapel of this college is placed the tombstone of one of the nun It was dug up many years since in the master's garden, which was formerly the burial-place of the nunnery. It has this inscription:

MORIBVS. ORNATA. JACET. HIC. BONA. BERTHA. ROSATA

It is said that a subterraneous passage is still in existence, communicating with the priory at Barnewell, the remains of which are about a mile from hence.

Christ's College stood formerly near Clarehall, on the side of a hotel called God's House, and was first endowed by William Bingham for 24 scholars, in 1442. It was removed to its present situation, on the north side of St Andrew's Street, by Henry VI., who intended to increase the establishment; but was prevented by the ensuing civil wars. His maternal sister, however, Margaret, countess of Richmond, fulfilled his intentions in 1506, and endowed it for a master and 12 fellows. It consists of an old quadrangular court, and a modern building behind, which was designed by Inigo Jones. In the gardens is shewn a large mulberry tree, that was planted by Milton, when a student here. The trunk is much decayed; but some of the scholars have endeavoured to preserve it, by covering the damaged parts with sheet lead.

St John's College owes its original endowment to the same Lady Margaret; but it was not completed till after her death, and was opened, in 1516, for a master and 31 fellows. It occupies the site of a priory of the same name, and consists of three courts, extending from St John's Street to the river. It is chiefly built of brick, and the entrance court from the street is ornamented with a magnificent portal and four towers. On the other side of the brook, which bounds the walks of this college, are the remains of an ancient and spacious building, called *Pythagoras' School*, or *Merton Hall*. Its walls are strengthened with buttresses, and supported by arches of the Saxon style; but the building is otherwise completely devoid of ornament, except one window on each side, which has a slender pillar in the centre, with a capital decorated with a round moulding.—This is supposed to have been the place where the monks of Croyland delivered their lectures. It is, however, now used as a barn.

Magdalene College is situated in Bridge Street, on the west side of the river, and was originally a priory for canons-regular, dedicated to St Giles. In the reign of Henry VIII., it was purchased by Edward, duke of Buckingham, who erected a part of the present building, and intended to have endowed it; but was prevented by his execution, and the consequent confiscation of his property. It was afterwards endowed for a master and four fellows, in 1542, by Lord Audley, chancellor of England, who obtained a grant of it from the king, and a charter of incorporation, under the name of St Mary Magdalene College. The chapel has a curious altar-piece of plaster of Paris, representing the two Maries at the sepulchre in alto relievo.

Trinity College occupies the site of two ancient colleges, St Michael's and King's Hall, and several hotels. It was founded and endowed by Henry VIII. in

1546, and possesses the richest revenues of any similar establishment in Cambridge. Its buildings are also very magnificent, consisting of two spacious but irregular quadrangular courts, the largest of which measures 334 feet by 325 west and east, and 287 by 256 north and south. The east entrance from the street is by a grand tower gateway, which is ornamented by a statue of Henry VIII., and a variety of carving; and the south gateway is surmounted with four lofty towers at the corners, and adorned with a fine statue of Queen Elizabeth in her robes. The chapel is built in the Gothic style, and was erected by the sister queens, Mary and Elizabeth. On the altar-piece is a fine picture of "St Michael and the Devil," by West; and on each side, an antique and curious piece of painting in perspective; the one representing our Saviour and St John the Baptist; the other, the Virgin Mary and the mother of St John. Behind the organ gallery is a statue of the immortal Newton, executed in a masterly style by Roubilliac, and erected at the expence of Dr Robert Smith. The philosopher is represented in a loose gown of a master of arts, with a prism in his hands. His countenance is turned upwards, with a look of profound and abstracted meditation, and on the pedestal is the inscription, *Qui genus humanum ingenio superavit.* The drapery and features are extremely beautiful; and the whole figure is considered one of the finest specimens of English statuary.

There is, perhaps, no object in the University better worth a stranger's notice, than the superb library of this college. It is a spacious apartment, occupying one side of the quadrangle called Neville's Court. The coup d'œil at entering is surprisingly grand; the books are ranged on either side, and the compartments severally crowned with busts of ancient and modern authors. There are likewise busts of Newton and Bacon, both members of this college, by Roubilliac, and many curious manuscripts and marbles presented to the college at different times by its members.

In the master's lodge are apartments for the chancellor and judges when they hold the assizes at Cambridge. At the installation of the Duke of Gloucester at the annual commencement in July 1811, twelve hundred persons, consisting of members of the senate, and strangers of distinction, were sumptuously entertained by his Royal Highness in the cloisters of Neville's Court.

Emanuel College occupies the site of a Dominican convent, on the north side of St Andrew's Street. It was founded in 1584, by Sir Walter Mildmay, and endowed for a master, three fellows, and four scholars. The altar-piece of the chapel is adorned with a fine painting of the "Prodigal Son," by Ammiconi.

Sidney Sussex College was originally a monastery of Franciscans, or Grey Friars, which was purchased by the executors of Frances Sidney, countess of Sussex, who had bequeathed 5000*l.* and some other property, for the foundation of a college, consisting of a master, 10 fellows, and 20 scholars. This bequest, however, being found insufficient to defray the expence of the buildings, &c. the fellows were reduced to seven. The chapel was rebuilt about twenty years ago; and has on the altar-piece, a fine painting of the "Nativity," by Pittoni, a Venetian.

In the master's lodge is a curious original picture of Oliver Cromwell, who was educated here.

Besides the colleges mentioned above, another is about to be established, by the name of Downing College, in pursuance of the will of Sir George Downing, Bart. who bequeathed several valuable estates, in failure of the issue of Sir Jacob Downing and his three sons, for the foundation of a college within the precincts of the university of Cambridge, to be called by his own name. On the death of Sir Jacob, who survived all his children, in 1764, the validity of the original will was disputed by his lady and her relations, and was not finally settled until 1800, when the great seal was affixed to the charter for the incorporation of the new college. The establishment is to consist of a master, a professor of the laws of England, a professor of medicine, and 16 fellows.

The master, professors, and four fellows, are already appointed, and considerable progress is made in the building, under that excellent architect, William Wilkins, Esq. It is to be of the purest Doric; the principal gateway to face the entrance to the town from London. When completed on Mr Wilkins' plan, it will be at once an ornament and honour to the University.

In the description of these colleges, we have mentioned only the number of fellows, &c. which were admitted upon each foundation on its first establishment. These, however, have been greatly increased by subsequent benefactions; and now amount to more than double the original number. The following list contains the number of fellows and scholar-ships belonging to each society, and the number of members attending the university in 1802. Each college has a master or head, who, in King's College, is called provost, and in Queen's, president.

	Fellows.	Scholarships.	Members.
Peter House,	22	48	69
Clare-Hall,	20		76
Pembroke Hall,	15		80
Bene't,	12	60	52
Caius,	26	77	104
Trinity Hall,	12	14	82
King's,	70		94
Queen's,	20		88
Catherine Hall,	14	26	28
Jesus,	16	41	102
Christ's,	15		101
St John's,	61	114	465
Magdalene,	17		61
Trinity,	60	69	548
Emanuel,	15	50	144
Sidney,	12		53
Total number of members,			2147

Those members, however, who are resident in the university during term, seldom exceed a thousand; and besides the fellows and scholars, there are also maintained upon the foundation about 230 inferior officers and servants.

The other buildings belonging to the university, are the senate-house, the library and schools, and the botanic garden. The senate-house, where all the public business of the university is transacted, is a superb edifice of the Corinthian order, erected in 1722, from a design of Sir James Burrell. It occupies the north side of a grand square, which has St Mary's church on the east, the library on the west, and on the south an empty space, on which it is intended to erect a building, which is to correspond exactly with the senate-house, and contain the consistory, registrar's office, &c. This structure is built of Portland stone, and is decorated with pilasters and a handsome ballustrade. On the south and east entrances are elegant pediments, supported by four fluted Corinthian columns, with finely carved capitals. The interior of the building, which measures 101 feet in length, 42 in breadth, and 32 in height, is ornamented with wainscots, carvings, and galleries of Norway oak; the ceiling is enriched with stucco work, which displays considerable taste, and the floor is laid with black and white marble in alternate squares. In the centre of the apartment, on the north wall, is a statue of George I., executed by Rysbrack; and opposite is a statue of George II., by Wilton. An elegant statue of the late Duke of Somerset when young, by Rysbrack, occupies the left side of the door at the east entrance; and on the right is an emblematical figure of Alma Mater, executed by Borotta, an Italian, and presented to the university by Sir Peter Burrell. On the scroll is inscribed:

Cuncti Adsint, Meritæq. Expectent Præmia. Palmæ.
"Let all be present, and expect the palm, the reward of merit."

A statue of the late Mr Pitt, for which 7000*l.* were raised by private subscription, is in the hands of Nollekens, and to be placed here.

The schools surround three sides of a small court, and were erected, in 1443, at the expence of the university, assisted by liberal benefactions. On the north side is the divinity school; on the west the philosophy school; and on the south the school for law and physic. The whole quadrangle over the schools is occupied by the library, which consists of four apartments, and was erected, in 1480, at the joint charge of Rotheram, archbishop of York, and Tunstal, bishop of Durham. The new room fronting the square, which was rebuilt in 1775, has a spacious piazza, and is surmounted with a handsome ballustrade and urns. In the vestibule are an antique colossal statue of Ceres, from the temple of Eleusis; the Cippus, from the tomb of Euclid, and a number of antique marbles, inscriptions, &c. which were brought from Greece by Dr E. D. Clarke, and Mr Cripps of Jesus' college. This library contains many valuable and curious manuscripts, among which is the Beza MS. of the four Gospels and Acts of the Apostles, supposed to have been written in the third or fourth century, and to be one of the oldest manuscripts extant.

The botanical garden lies at the south-east end of the town, near Bene't College, and contains nearly five acres, richly stored with all kinds of plants, arranged according to the Linnæan system. An elegant green-house, above 100 feet long, has been lately erected; and also a large and handsome building for the botanical, chemical, and mineralogical lectures.

In the university of Cambridge every college is a corporate body, governed by its own statutes, but under the controul of the common laws of the university. The government of the whole is vested in the *senate*, and certain magistrates and officers of its appointment. All doctors and masters of arts are members of this body, which is divided into two houses, denominated *Regents*, and *Non-Regents*.—Masters of arts of less than five years standing, and doctors of less than two, constitute the Regent, or Upper House, which is also called the White Hood House, from its members having their hoods lined with white silk; all the rest belong to the Non-Regent, or Lower House, otherwise called the Black Hood House, from the colour of the lining of their hoods; but the public orators, and all doctors of more than two years standing, may vote in either house. A committee of the senate, called the Caput, which is chosen annually, and consists of the vice-chancellor, a doctor of each faculty, and a regent and non-regent master of arts, consider and determine what *graces* or bills are to be laid before the senate; and every grace must have their unanimous approbation before it can be admitted. The public officers of the university are, the chancellor, who is, in general, one of the principal nobility, and possesses the sole executive authority within the limits* of the university, except in matters of felony; the high steward, whose duty is to assist the chancellor and other officers when requisite, and to hear and determine capital causes; the vice-chancellor, who is always a master of some college or hall, and upon whom the management of the university devolves in the absence of the chancellor; two proctors, who must be regent masters of arts, attend to the discipline of the bachelors and under graduates, and read the graces and register the votes in the White Hood House; two taxors, who regulate the markets, and take cognisance of weights and measures; two moderators who superintend the exercises and disputations on philosophical questions, and also the examinations previous to conferring the degree of bachelor of arts; two scrutators, who are non regents, and who read the graces and collect the votes in the Lower House; the public orator, who is the mouth of the senate on all public occasions, reads and writes all its letters, and presents to all honorary degrees, with an appropriate speech; and the commissary, who is assistant, or assessor, to the vice-chancellor. Here are also a registrar, three esquire bedells, and two librarians; besides a number of inferior officers, who are appointed by the vice-chancellor, and hold their offices for life.

Besides the fellows and scholars, who are maintained upon the foundations, there are two other classes of students, called Pensioners and Sizars.—The greater pensioners, who are generally the younger sons of the nobility, or young men of fortune, have the privilege of dining at the fellows' table, and are also called Fellow Commoners; while the others dine with the scholars, but both live at their own expence. The sizars are commonly men of inferior fortune, who are assisted in prosecuting an expensive education by exhibitions and other benefactions. These, however, frequently succeed by merit to the highest honours and emolument of the university; and it is from this class that most of the dignitaries of the church of England have been taken.

Several prizes, to the value of 639*l.* 5*s.* are annually distributed for the encouragement of science and classical literature. Those which are open to the whole university, amount to 353*l.* 5*s.*; the rest are confined to individual colleges.

Cambridge possesses several charitable institutions, among which the principal is Addenbrooke's Hospital, which is the general infirmary for the town and country. It received its name from John Addenbrooke, an eminent physician, who bequeathed, in 1719, about 4000*l.* for its erection, and was first intended merely for the gratuitous cure of the indigent sick. Its original design, however, was changed in 1766, when it was converted into a general hospital; and since that time it has been calculated, that 700 persons have been annually admitted and relieved. The free grammar school, which was founded in 1615, in pursuance of the will of Stephen Perse, for the accommodation of 100 boys, is now so miserably mismanaged, that the school is deserted, and two or three scholars receive their lesson at the lodgings of the master. There are, however, a number of charity schools in Cambridge, which are well supported by endowments, benefactions, and voluntary subscriptions; and several alms-houses have been endowed by generous and humane individuals, for the reception of the aged and infirm poor, who are comfortably lodged and maintained.

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* The jurisdiction of the university extends a mile every way round from any part of the suburbs.

On the site of the old castle of Cambridge, a county jail has been lately erected, from a convenient and extensive plan of the celebrated Howard. This castle was built, or, according to Fuller, "re-edified," by William the Conqueror, in order to ensure the submission of the monks of Ely, who had attempted to resist his authority. The gate-house is the only part now standing, the rest of it having been demolished in the reigns of Henry IV. and Queen Mary, and its materials appropriated to other buildings. Near it, and within the bounds of the intrenchments, is a high artificial hill, which is supposed by many to have been raised by the Britons before the Roman invasion. It commands a fine view of the town and the surrounding villages; and the prospect is terminated by Ely cathedral, which is about 17 miles distant, and can be clearly distinguished by the naked eye. The town jail, with a bridewell contiguous to it, stands on the opposite side of the town.

Cambridge has no manufactures of any consequence, and very little business is carried on here, except what is immediately or remotely connected with the university. Its numerous shops furnish the different colleges with every necessary; and the tutors are answerable for the payment of the bills of their respective pupils. The markets are abundantly supplied, and are under the jurisdiction of the university. From its convenient situation, however, as the head of inland navigation from Lynn, it has a considerable trade in oil, iron, coals, and corn. Great quantities of butter are brought every week from Norfolk and the Isle of Ely to this city, from whence it is sent to London. What is sold in Cambridge is made up in rather a singular way, every pound being rolled out to the length of a yard, for the convenience of dividing it into small portions, called *sizes*, for the use of the students. It has two annual fairs; Midsummer, or Pot Fair, as it is called, from the great quantity of earthen ware which is then exposed to sale, is held on a common, near Jesus' College; it commences on Midsummer day, and continues a fortnight. Sturbridge Fair begins on the 18th of September, and continues the same time. It is held in a field, about a mile from the city, and was formerly a celebrated mart of trade, and the largest fair in England. Though greatly declined, it still retains a large trade in wool, hops, leather, cheese, and iron; and two days are appropriated to the sale of horses

Cambridge, since its first establishment as a seat of learning, has been exposed to various changes of fortune. The first school for the instruction of youth in this place, is supposed to have been instituted by Sigebert, king of East Anglia, about the year 631. It would appear, however, that in the time of Alfred, this institution no longer existed, as that prince complained, "that he could find no teachers when he had youth and leisure to be instructed;" and we learn from the chronicle of the Hyde-Abbey, that Edward the Elder erected "halls for the students, and chairs and seats for the doctors, at his own charge." In 1010, the town was plundered and burnt by the Danes; and in the reign of William II. it underwent a similar misfortune from Roger de Montgomery, in retaliation for some affront given him by the king, when the university was for some time abandoned. Though Henry I. in order to induce the students to return, invested the town with several valuable privileges, yet it continued in a very languid state, until "Joffrid, abbot of Croyland," according to Peter Blerensis, in his Appendix to Ingulphus, "sent to his manor of Cottenham, near Cambridge, Gilbert, his fellow monk, and professor of divinity, who, with three other monks that had followed him to England, and were well versed in philosophical theorems, and other primitive sciences, repaired daily to Cambridge, and having hired a public barn, made open profession of those sciences, and soon collected a great number of scholars."—"Out of this little fountain, increased to a great river," continues the same author, "we see how the city of God has become enriched, and England rendered fruitful by the many masters and teachers going forth from Cambridge as from paradise." Its prosperity, however, was again checked by a dreadful fire in 1174, which destroyed most of the churches and houses, and "only stopt," says Fuller, "for want of fuel to feed its fury." During the contest between King John and his barons, the town was successively pillaged by their forces; and in 1281, some very serious disputes arose between the members of the university and the townsmen, concerning their respective rights, which terminated in open hostility. The towns people having assembled in a tumultuous manner, committed many flagrant acts of violence against the university. They carried off its charters, records, and other papers, which they burnt in the market-place, and compelled the chancellor and other officers to renounce, under pain of death, all the privileges that had ever been granted to it, and to sign a bond, investing its entire future government in the burgesses of the town. But these daring proceedings were soon stopped by the appearance of the Bishop of Norwich, who having entered the town with a few soldiers, restored for a time tranquillity to the city, and punished the principal offenders. The mayor was deprived of his office, the liberties of the town were forfeited, and given to the vice-chancellor; and though the corporation was afterwards restored in the reign of Henry VIII., many of its former privileges remained with the university. The animosity between the two parties, however, continued, which often burst forth in acts of hostility and commotion; and peace was not completely restored to this university until the reign of Elizabeth. About six years after her accession, this princess visited Cambridge, where she was entertained with various dramatic exhibitions, besides orations, disputations, and other academical exercises; and, at her departure, she recommended to the university, in an elegant Latin speech, "to make the result of their studies public, and lamented that her predecessors had so provided them with splendid buildings, that she was placed in the situation of Alexander, who was grieved when he had no more provinces to bestow; but promised to retain their interest in her memory till circumstances admitted of her making a provision for them adequate to her intentions." In 1630, this city was visited with a dreadful plague, which carried off between three and four hundred of its inhabitants. The students were obliged to retire to their respective homes, and the assizes were removed to Royston. In the contest between Charles I. and his parliament, the university of Cambridge took part with the king, and sent a quantity of their plate to be converted into money for his use. This exposed them to the displeasure of Cromwell, who deprived them of some of their privileges, and levied heavy contributions upon the city. Upon the restoration, however, these privileges were restored, and many new improvements and regulations were adopted, which have greatly contributed to the peace and prosperity of the university. Since that time, the advancement of its reputation as a seat of learning has been uniform and uninterrupted.

The government of the city of Cambridge is vested in the officers of the university and the corporation, the vice-chancellor being always a magistrate by virtue of his office. The corporation consists of a mayor, high steward, recorder, twelve aldermen, twenty-four common council men, four bailiffs, a town-clerk, and other officers. It sends four members to parliament, two for the university, who are chosen by the senate, and two for the city, who are elected by the mayor, bailiffs, and freemen not receiving alms, amounting in all to about 200 voters. According to the census of 1801, Cambridge contained 1691 houses, and 10,087 inhabitants, of whom 1306 were returned as employed in trade and manufactures, and 811 as belonging to the university; and in 1811, the total population was 11,108. North lat. 52° 12′ 36″; East long. 0° 4′ 15″. See *Beauties of England and Wales*, vol. ii. p. 21—109; Harraden's *Cantabrigia depicta*, Camb. 1811; and the *Cambridge Guides*. Lond. 1794. (1.)

CAMBRIDGESHIRE, one of the inland counties of England, is bounded on the north by Lincolnshire, on the north-west by Northamptonshire, on the west by Huntingdonshire, on the south west by Bedfordshire and Hertfordshire, on the south by Essex, on the south-east by Suffolk, and on the north-east by Norfolk.

The northern part of Cambridgeshire consists chiefly of what is called the Isle of Ely, which is a separate district, possessing a jurisdiction of its own. The greater part of this tract is fenny ground, intersected by innumerable channels and drains, and forming part of a very spacious level, stretching into the counties of Norfolk, Suffolk, Lincoln, and Huntingdon. In the midst of these level marshes, the towns and villages built upon the elevated grounds rise like islands from the sea, and may be distinguished at the distance of several miles. All the low grounds which are formed by the stagnation of water from the overflowing rivers of this tract, are naturally boggy; but, by cutting drains and erecting embankments, considerable portions of it have been converted into fertile water meadows, or into good arable land, which produces from forty-five to sixty bushels of oats per acre. Wheat and cole-seed are also grown in considerable quantities; and, in the north-western part of the county, several thousand acres are laid out in excellent pasture.

In the part of the county which borders on Norfolk, particularly in the neighbourhood of Elm, Upwell, and Outwell, hemp and flax are produced in abundance. Butter of the finest quality is made in the dairy-farms of this district; and, owing to the peculiar nature of the pasturage in the neighbourhood of Cottenham, the cheese of that place is remarkable for a flavour particularly delicious. Calves are also suckled here for the London market. The growth of corn in the north-west corner of the county is particularly favoured by the rich marshes; but the luxuriant crops which it produces are often destroyed by the high floods which inundate the county in rainy seasons.

The south and the south-western part of Cambridgeshire, which is watered by the Cam, is the most fertile and agreeable. The land is considerably elevated, and produces wheat, barley, and oats, in great quantities, while many thousands of sheep of the Norfolk and west country kinds are pastured on the heaths and commons with which those districts are intersected. Saffron is cultivated in some of the parishes which border upon Essex; and the valley of the Cam, from Steeple Morden to Walton, is denominated the *Dairies*, from being wholly appropriated to dairy farms.

The district in the south-east of the county, which extends from the Gogmagog hills about four miles to the east of Cambridge, to the town of Newmarket, is bleak and thinly inhabited. Barley is grown in some of the more fertile portions, but the rest is chiefly applied to sheep-walks. This division is connected with that immense tract of land which stretches into Essex, Suffolk, and Norfolk, and forms one of the most extensive downs in England.

In this county there is a very considerable variety of soil. Chalk, gravel, loam under clay, and clay upon gualt, form the soil of the upland districts. In the fens, the soil is a strong black earth, or moor, lying on a gualt of gravel, or turf moor, and is very favourable to the cultivation of oats and cole seed. In the nighbourhood of Wisbech, the soil is a mixture of sand and clay, or *selt*. In the cultivation of these different soils, oil-cake dust, pigeons dung, decayed woollen rags, soot, &c. are employed as auxiliaries to the common manures. The soot is generally laid on in spring, at the rate of 20 bushels an acre, for the purpose of driving away the wire worms which infest the heavy and light soils. These worms, which are of a yellow colour, and resemble the centipede, would otherwise destroy the wheat. No particular attention is paid to the making of dunghills. "The drill husbandry," say the learned authors of the Beauties of England and Wales, "till lately had been chiefly employed at Wimpole, on the estate of Lord Hardwicke, but appears to be fast spreading, and, with the introduction of some new agricultural machines, promises to become of essential service. The general rent of farms is from 50*l.* to 350*l.* per annum; but the rental of some in the neighbourhood of Wisbech are as high as 800*l.*, and one in the parish of Wood Ditton is occupied at the rent of 1000 guineas yearly. The woodlands are extremely small, the whole quantity of timber throughout the county scarcely amounting to 1000 acres, and these principally scattered through the parishes of Stackworth, Wood Ditton, Linton, Bartlow, Boxworth, Wimpole, and Madingley.* The greatest part of the land is open field; but the inclosures are rapidly taking place, new bills for that purpose being applied for and obtained, every session of parliament. Manufactures are hardly known in this county; and, with the exception of those persons who obtain subsistence by making the celebrated white bricks, and coarse pottery with the same clay, in the neighbourhood of Ely, most of the inhabitants are employed in agriculture; others derive support from spinning yarn for the Norwich weavers." The principal breeds of sheep in this county are the Norfolk, the West Country, and the Cambridgeshire. The number of sheep amounts to about 152,928. The extent of highland country upon which they pasture is about 243,300 acres.

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* The chalky lands are well fitted for the growth of beech, and there are many places well adapted for the cultivation of oaks, ash, and elm.

The chief rivers in Cambridgeshire are the Ouse and the Cam. The Ouse rises in Northamptonshire, and after watering Buckinghamshire and Bedfordshire, it enters Cambridgeshire between Fenny Drayton and Erith, from which it runs eastward through the fens, till at some distance above Denny abbey it turns to the north, and passing Streatham, Ely, and Littleport, it crosses the north western part of Norfolk, and flows into the sea at Lynn Regis. The Cam, or Granta, which probably received its name from its crooked course, has three branches, the principal of which rises at Ashwell in Hertfordshire, and enters Cambridgeshire to the west of Gilden Morden. After flowing to the north-east and receiving several rivulets, it is enlarged near Grantchester by the united waters of some streams which rise in the county of Essex. After this junction, it takes a northerly course, flows through the walks of the chief colleges in Cambridge, and falls into the Ouse at Harrimere in the parish of Streatham.

Besides these rivers, there are numerous artificial streams in the northern part of the county for carrying off the surplus water of the fenny grounds. The principal of these drains are the old and new Bedford rivers, which are navigable for more than twenty miles from Erith to Denver. It is in contemplation to cut a canal from Clayhive, seven miles below Cambridge, to Saffron Walden and Bishops Stopford, in all a distance of 25 miles; by this means the inland navigation from Lynn and from Cambridge to the metropolis would be completed.

The *Great Level* of the Fens, which lies in the counties of Cambridge, Huntingdon, Northampton, Lincoln, Norfolk, and Suffolk, includes nearly 400,000 acres, and appears to have been formerly firm and dry and cultivated land. Great quantities, both of the trunks and the roots of fir and oak trees, and of furze and nut bushes, standing in the solid earth, have been found at various depths in the fens; and it appears from the description of the Fenny country, given by Henry of Huntingdon, who lived in the time of King Stephen, and of William of Malmsbury, who lived in the first year of Henry II., that it was covered with fine wood, and was in every respect a flourishing and agreeable district. A few centuries afterwards, however, the fens were covered with water, and reduced to the state of a morass: the health of the inhabitants was destroyed by the noxious exhalations from the stagnant waters: the county was rendered impassable even to boats from the sedge, reeds, and slime with which it was covered; and the inhabitants were in danger of perishing for want of food.

As early as the reign of Edward the First, attempts were made to drain the fens; and in the subsequent reigns of Edward III., Elizabeth, Charles I., Charles II., &c. these attempts were continued with various success. In the year 1795, a bill was carried in parliament for improving the outfall of the river Ouse, and the drainage of the South and Middle Levels, by making a cut across the marshes from Eaubrink to Lynn; a plan from which very considerable advantages are expected. Great numbers of windmills have been erected for the purpose of conveying the water from the wet grounds; but in spite of all the measures which have been taken for this purpose, the crops are often carried away by inundations, and the best land overwhelmed and rendered useless. Nearly 150,000 acres of fenny ground are still in an unimproved state, and their average value scarcely exceeds four shillings per acre. The Cambridgeshire canal commences in the river Ouse, at Harrimere, and terminates in the town of Cambridge. A cut of three miles extends to Reche, and another of three miles and a half to Burwell. The river Cam is embanked in all its lower parts above the adjoining fens. It has no locks in some parts, but it has sluices for making flushes of water to enable boats to pass the shallows.

This county is not distinguished by numerous remains of antiquity. At a short distance from the village of Chesterton are seen some vestiges of a Roman camp, called Harborough, or Arbury, of a form nearly square. Three parts of the vallum which yet remain, enclose nearly six acres of ground, in which several Roman coins have been found, one of which had the head of Rome on one side, and Castor and Pollux on horseback on the reverse. On the Gogmagog hills, about four miles to the east of Cambridge, and the highest hills in the county, are the remains of a fort or camp, which has three ramparts and two grafts. It is nearly circular, and is about 246 paces in diameter, enclosing about thirteen acres and a half of ground. It cannot be ascertained whether this camp was the work of the Romans, Britons, or Danes; but some are of opinion that it was erected by the British as a check to that of the Romans at Harborough, which is situated directly opposite to it. A Roman highway runs southward from the brow of the hill, and points directly to Cambridge, according to Gale, or to Grantchester, according to Horsley. Several Roman coins were found here in digging a cellar in 1685. At a place beside the river, called Damhill near Trumpington, many urns containing human bones, have been found at different times; and also several vases and paterae. Hence it has been regarded as a Roman burying place. In the year 1694, when some husbandmen were ploughing a field, they turned up several ancient coins, some large gold rings, and a thin plate of lead. One of the labourers then thrust his hand into the earth, and brought out three silver plates of a circular shape, and about six inches in diameter. The two largest were kept together by a small silver rivet passing through their centres, and on one of them were some knobs and figures, and a Dano-Saxon inscription. Excepting the three first words, which are unintelligible, the inscription, which proves it to have been a charm or amulet, may be thus translated: "O Lord, Lord, him always defend who carryeth me about with him; grant him whatever he desires." In the year 1730, when the road was making from March to Wisbech, three urns were discovered full of burnt bones and ashes, and also a pot containing 300 pieces of silver coin of all the emperors from Vespasian to Antoninus Pius. An altar, 21 inches high, was found at Ely; and at Welney, various coins have been discovered in urns. At the village of Arrington, the skeleton of 16 human bodies was found in 1721, in digging for a water course, and within two feet of the surface. The bones were lying irregularly, some in heaps, and others of the parts of only one skeleton. In a burrow between Haslingfield and Comberton, was found a freestone coffin, covered with a stone inlaid of divers colours.

Cambridgeshire is about 50 miles long, about 25 miles broad at its southern and western extremity, and 130 miles in circumference. It contains 686 square miles, 437,040 square acres, about one third of which is arable, one third in pasturage, and the other third in an uncultivated state. The number of houses in 1801, is 16,139, and the population 89,346; the number of males is 44,081, and the number of females 45,265, of whom 11,988 were returned as employed in trade and manufactures. The population, according to the new returns in 1811, is 100,109. There are 160 parishes in Cambridgeshire, one city, Ely, and nine market towns, viz. Cambridge, the county town, Caxton, Linton, March, Newmarket, Sohans, Thorney, Wisbech, and part of Royston. It is divided into fifteen hundreds; sends six members to parliament, two for the county, two for the town, and two for the university. This county is the diocese of Ely, and in the Norfolk circuit. It pays nine parts of the land tax, and furnishes the militia with 480 men. In 1806, the total return of income under the property tax was 1,224,197*l.* The amount of the poors rates in 1803, was 105,376 at 4s. 8½d. in the pound. See the *Description of England and Wales*, vol. i. p. 220; the *Beauties of England and Wales*, by Brayley and Britton, vol. ii. p. 1; and Vancouver's *General View of the Agriculture of the County of Cambridge.* (*o*)

CAMBYSES. See PERSIA.

CAMDEN, WILLIAM, one of the most learned men that this country has produced, was born at London in 1551, of respectable, but not opulent parents. He received the rudiments of his education in Christ's hospital; was afterwards sent to St Paul's school; entered, at the age of fifteen, a servitor at Oxford; and laid the foundation of his classical erudition under Dr Thomas Cooper, who was afterwards Bishop of Lincoln. By the influence of the Popish party, he was disappointed of a fellowship; and soon after went to London, where he successfully prosecuted his studies, his literary friends kindly supplying him with money and books. In 1573 he returned to Oxford, where he obtained the degree of Bachelor of Arts; and, two years afterwards, he was appointed second master of Westminster school, the duties of which office he discharged with fidelity and diligence, and rose to the rank of head-master in 1593. Notwithstanding the laborious duties of his office, he found time, while at Westminster, to collect and prepare materials for his great work *Britannia, a chorographical description of the kingdoms of England, Scotland, and Ireland, with the adjacent Islands, with an account of the origin, manners, and laws of the inhabitants, from the remotest antiquity.* This learned work established his reputation as a scholar all over Europe. In 1593, he published a fourth edition of it in folio, much enlarged and improved, and embellished with valuable maps; for which he had been at great pains to collect new materials, and to avail himself of the information of his literary friends. It was, however, severely criticised, and charged with many errors, which obliged its author to revise it anew; but while he candidly acknowledged and corrected his mistakes, he also proved, from various undoubted authorities, that he had in many instances been unjustly attacked. The edition which received his finishing hand was printed in 1607. Dr Holland of Coventry having published a translation of it in 1611, in which he had inserted several articles of his own, Edmund Gibson of Oxford, afterwards Bishop of London, gave a new translation of it in 1695, free of all interpolations: but, because Holland's additions were often valuable, and because it was generally believed that he had consulted Camden himself when he met with any difficulties, Gibson preserved them, and placed them at the bottom of the page. He also added remarks of his own at the end of each county, either to confirm what Camden had advanced, or to supply his defects; with a list of the persons by whom he was furnished with his materials. This edition was published in two volumes folio in 1722, under the bishop's own inspection: but the public has been favoured with a new translation, and much improved edition, by the learned Mr Gough, who has enlarged it to nearly double the size of the preceding edition.

In 1597, Camden published a Greek Grammar, which was taught in all the public schools in the kingdom, and ran through nearly a hundred editions. In the subsequent year, he was taken from the office of schoolmaster, and promoted to the higher one of Clarenceux king at arms. In 1600, he published an account of all the monuments in Westminster Abbey, with their inscriptions; and in 1603, a collection of the ancient historians of Britain, was sent from the press at Frankfort, under his superintendance, which he had originally intended as the ground work of a civil history of England. After the discovery of the gunpowder plot, King James, desirous to guard the reformed churches on the continent against the enemies of the Protestant religion, as well as to satisfy foreign princes of the justice of his own proceedings against the conspirators, made choice of Camden as the fittest person to draw up in Latin a narrative of that infamous plot. He executed this work with great accuracy, spirit, and elegance; and in testimony of its having received the royal sanction, it issued from the press of the king's printer. In 1615, he published in Latin his Annals of Queen Elizabeth, also under the sanction of his sovereign, and with this solemn appeal to posterity for his veracity as a historian, "I dedicate and consecrate it at the altar of truth to God, to my country, and to posterity." From the reputation of the author, this work raised great expectations, which were not disappointed. It is a valuable historical composition, although, in the opinion of many, the reign of that illustrious princess is drawn with a partial hand. The favourable reception which the first part of that work received from the public, might have determined him to proceed, had he not been sensible of the inconvenience attending the publication of a history, while the persons who had borne a distinguished part in it, or their immediate descendants, were still alive. This consideration made him resolve that the second volume should not be published till after his death, and left him at liberty to prosecute his history with that spirit of impartiality and freedom, with which he had so solemnly professed to guide his enquiries. That it might be given to the public in an entire state, he caused one copy to be deposited in the Cotton library, and another to be lodged with a friend for publication, who undertook faithfully to execute the trust committed to him.

Besides the foregoing works, he wrote many valuable essays on British antiquities, at the request, and in compliance with the practice, of the learned society of antiquaries, some of which have been published by the laborious Hearne, in his collection of discourses on English antiquities; and these give reason to regret that others have been lost, which would have thrown light upon those subjects. This eminent scholar concluded his services to the republic of letters, by founding a professorship of history at Oxford, for which he may be reckoned among the chief benefactors to that university; the first professor being nominated by himself in 1622. He died the following year at his house in Kent, in the 73d year of his age; and by his will, written by himself on the last anniversary of his birth, May 2, 1623, (an anniversary which, as appears by his diary, was always spent in charitable deeds and pious meditations,) he modestly directed that he should be privately buried at whatever place he should die. But his executors did not obey his injunctions. They interred him with great pomp, in the south aisle of Westminster Abbey, opposite to the tomb of the poet Chaucer; and caused a handsome statue of white marble to be erected to his memory, holding in his hand a book, with *Britannia* inscribed on it.

Camden was not more distinguished by his learning than by his virtues. His character is thus summed up by one of his biographers. "In his writings he was candid and modest; in his conversation easy and innocent; and in his whole life even and exemplary. When he was young, learned men were his patrons: when he grew up, the learned were his intimates: and when he became old, he was the patron of the learned: so that learning was his only study, and learned men his only society." The high reputation which his writings acquired among foreigners, is both honourable to himself and to his country; and it might have been in a great measure owing to the mildness and candour of his disposition, that few who have been so eminent in the republic of letters, have suffered so little from the critical censures of cotemporary writers. That he maintained a very extensive correspondence with learned men, both at home and abroad, appears from his letters and annals, which have been given to the public; and such was his reputation as a scholar, all over Europe, that it was deemed a great omission in a foreigner to visit England, and return without seeing Camden. See *Biog. Brit.*; Bishop Gibson's and Smith's *Lives of Camden.* (A. F.)

CAMEL, a genus of quadrupeds belonging to the order *pecora* of Linnæus, the principal generic and specific characters of which we shall reserve for their proper place, under MAMMALIA, and here confine ourselves chiefly to the domestic uses to which this animal is converted.

The camel is one of the larger quadrupeds, being six or seven feet from the ground to the highest part of the back, and it carries the head when erect about nine feet above the plane of its position. The carcase weighs three or four hundred pounds; but the size and weight are far from alike in all.

Notwithstanding our familiarity with this animal, the different species and varieties are by no means well understood, which produces some inconsistency in a general account of the properties it possesses. There are two species so distinct, however, that they cannot possibly be mistaken; the one the Bactrian or Tauridan camel, having two bunches on the back, and the other of somewhat smaller size, lighter made, and more active, called the Arabian camel or dromedary. It is this latter only which is most generally alluded to under the name of camel.

Certain authors have described four, which they conceive distinct species of camels. 1st, The Turkman camel, which is larger, stouter, and of a darker colour than the rest. It requires more careful feeding, is less capable of resisting excessive heats, and of enduring privations, and is more untractable. 2d, The Arab camel, of smaller size, less hairy, and not so dark in colour as the former, and which can endure the want of water. 3d, The dromedary, which some think is a high breed of the Arab camel, with a smaller bunch, more agile, and able to travel three or four times as far in the same time as the others. 4th, The Tauridan or Bactrian camel, with two bunches, belonging to Persia, or the countries adjacent to the Crimea, and perhaps found on the confines of China, larger than the first, more hairy, and of different colours, between deep brown and dun. It appears that there is considerable variety in the colour of the camel, and that the goods manufactured from its hair are most esteemed, when approaching nearest to white or black.

One principal characteristic of the whole race is the prominence on its back, which is of a fleshy or glandular consistence, but not produced by a curvature of the spine. Zoologists have therefore indulged an hypothesis, that it was not implanted there by the hand of nature, but that it originated from the treatment of the animal, and is now transmitted in the breed as a generic character. Admitting that climate, treatment, and accidental circumstances can have very great influence on the structure and disposition of animals, we cannot agree that such a singular alteration has taken place in the conformation of the camel.

The natural abode of this animal is in the warmer climates, and places abounding with sand, where food is scanty, and exposure to long protracted privations are unavoidable; insomuch that, from the configuration of its foot, difficulty is experienced in treading another soil, and in the richer or more fertile countries where attempts have been made for its naturalization, it grows feeble, languishes, and dies.

The motion of the camel is unlike that of most other animals; both the feet on the same side are successively raised, and not alternately like those of the horse. Its pace is naturally slow, and when accelerated, the rider experiences the most severe jolting, which it requires continued practice to endure.

Properties which are denied to the greater part of quadrupeds are possessed by the camel, and in their fullest extent converted to the use of mankind. It is docile, patient of labour, and capable of abstinence in a wonderful degree; it can endure scorching heats with impunity; it feeds on thistles, on the stunted shrubs and withered herbage of the desert, and can pass successive days in total want of water; thus seeming as if purposely devised by nature for the most cheerless and inhospitable regions.

But these properties are improved to a great extent, by the mode in which the camel is reared. At the earliest period, the legs are folded under the body, in which position it is constrained to remain. Its back is covered with a carpet, weighed down by a quantity of stones gradually augmented: it receives a scanty portion of food: it is rarely supplied with water; and, in this manner, is regularly brought up in a system of privation. When the time of trial has elapsed, and it is broke into subservience, it kneels at the command of the master, who either mounts it himself, or loads it with a heavy burden;

and, trusting to its strength, and the privations it can suffer, he ventures to traverse the trackless desert.

A strong camel is able to carry 1000 pounds, and some are laden with 1500, for short journeys, or to escape the tribute on single burdens. The usual weight in long expeditions is, from 500 to 800 pounds, so disposed, that half the weight hangs on each side, and it is different according to the species employed. Yet under such a heavy load, though care be taken to feed a camel before the outset in proportion to the fatigue to be supported, it is afterwards sustained on an inconsiderable quantity of beans, or a few small balls of barley meal daily, thrown on the ground when it halts. Whole days, however, may elapse, without the animal tasting water, or being injured by the want of it. Travellers frequently speak of having experienced this in long marches. Tavernier occupied 65 days in crossing the great desert, and nine of these once intervened without finding water. Leo Africanus maintained, that camels could resist fifteen days complete privation of it without prejudice, a fact which receives confirmation from the recent observations of Dr Russel.—The camels of a caravan, from Bussorah to Aleppo, he observes, subsisted the like space of time without water; which was reckoned an extraordinary circumstance, and nothing of this kind was recollected by the natives. But we must not suppose, that these animals are insensible of thirst: for, after long privation, they drink with such avidity that the quantity swallowed often proves fatal: and it is related of a caravan to Mecca, which had endured great extremities for want of water, that the camels set off at full speed, when they became sensible of its presence, and rushing furiously into a pool, drank so immoderately, that many died on the spot. It is said, that they can distinguish the presence of water at the distance of two or three miles. Notwithstanding the camel can resist such long privations, yet these have their limits, and protracted abstinence cannot fail to prove destructive. Of this a melancholy example happened in the year 1805, when a caravan, in its progress across a desert, was disappointed of finding a spring at the usual place. On this occasion no less than 1800 camels and 2000 persons perished of thirst.

Physiologists, in accounting for the peculiar property of the camel, in resisting the want of water, have supposed that it is provided with an additional stomach of particular configuration, to retain what is imbibed. M. Daubenton, in dissecting a camel which was dead ten days, and had been carried fifty miles, found a quantity of clean insipid water in the deep cells of one of the stomachs: and it is well established, that in situations of urgent necessity, travellers have killed their camels to obtain the water contained in them. One of the Arabian historians, in recording the sufferings of Mahomet's army in an expedition against the Greeks, states that this alternative was resorted to: and, more recently, a similar fact is mentioned by Mr Bruce. Two of the camels, that would not rise after an exhausting march, were killed, and about four gallons of water, of a bluish tint, vapid, and void of taste or smell, were taken from the stomach of each. Nevertheless, it does not appear that there is a particular reservoir for the purpose; and there is reason to think that the same purpose is fulfilled by the singular structure of the second stomach. Being composed of numerous cells, several inches deep, the orifices of which are apparently susceptible of muscular contraction, it is conjectured, that when the animal drinks, it has the power of directing the water into these cells, instead of allowing its passage into the first stomach. But it will be received here when these are full; and, in this manner, a quantity of water may be kept separate from the food. From the structure of the second stomach, it neither receives food in the first instance, nor does it afterwards pass into its cavity. The orifice of the cells composing it are so constructed, as to prevent the entrance of solid food into them.—That the natural repugnance at drinking water from the stomach of an animal may be conquered it is not difficult to believe, when we are told, that on occasions of scarcity, above an hundred guineas have been given for a single draught.

The progress of the camel is in general slow, especially when collected in numbers to compose a caravan; but its pace is regular and uniform, and constitutes no inaccurate measurement of distance over desolate regions, where there is no guide. Travellers have frequently remarked, that the caravan then advances only between two or three miles an hour, and continues but seven or eight hours in motion; though from extraordinary exertions, or the peculiarity of circumstances, the latter period may be considerably protracted in a day. But, from careful calculation of the time employed in long and painful journeys, two miles and a half an hour is the result. This was found in crossing the great desert, which extends 720 miles; and also in the little desert, which stretches above 450 miles between more fertile countries. It does not appear that the load of the camel materially affects its progress; and that the chief difference in that case lies in the daily duration of the march. One which carries but little in addition to the weight of its rider, travels an hour and a half or two hours longer every day in distant journeys.

But among the different species or varieties of the camel, some are endowed with uncommon speed, and emphatically called by the eastern nations *camels of the wind*. This, the Arabs figuratively express, 'when thou shalt meet a *heirie*, and say to the rider, "Salem Alick," ere he shall have answered thee, "Alick Salem," he will be afar off, for his swiftness is like the wind.' There are many gradations, however, in the fleetness of these animals, which are trained for the saddle only, and are invariably of the Arabian, or one bunch kind. But a camel endowed with this property is rarely found. The ancients relate, that a journey, which usually occupied 30 or 40 days, was performed in eleven, with camels of the dromedary species, when Alexander commanded Parmenio to be put to death; and Leo Africanus observes, that many dromedaries will go an hundred miles daily, for eight or ten successive days.

These assertions are fully confirmed by modern observations, from which we learn that the name of this fleet animal is *mahari*, *el heirie*, or *erragual*, to distinguish it from *djimmel*, by which name the ordinary camel is known to the Arabs. Its properties are of different degrees, according to the various breeds or races, which as yet are not sufficiently illustrated; but it is evidently of smaller size and lighter make than any of the other species hitherto described. The camel which can go three days journey in one is called *talatayee*: one, called *sebayee*, whose qualities are greater, can perform a journey of seven days in the same space of time, and this is the general characteristic. But there is still a third, endowed with such fleetness, as to be capable of accomplishing nine days journey in one, which is denominated *tasayee*. This animal is so rare, that 200 common camels are given in exchange as its value. Provided with a goat-skin of water, a few dates, and some ground barley, the hardy Arab, having his loins, breast, and ears bound round to resist the percussion of the air, ventures on the swiftest excursions through the deserts, while the heirie is allowed water only once in seven days. Sonnini relates an extraordinary journey by a Bedouin Arab, who travelled from Cairo to Mecca in five days, which commonly requires thirty: Mr Jackson affirms that a *sebayee* once came from Fort St Joseph, on the river Senegal, to Mogador, which can be scarce less than 900 miles in seven days. An Arab also assured him, that he knew a youth of Magador passionately enamoured of a beautiful young woman, whom nothing would satisfy but oranges from Morocco. Mounting his heirie at dawn, he departed and returned with the object of his mistress's desire to Mogador the same night, though the distance between the two cities is an hundred miles. Probably this is the species of camel spoken of by Chardin, so fleet that a horse only at full gallop can keep up with it. M. d'Obsonville observes, that he saw a stud of 200 in possession of an eastern prince which could travel thirty leagues a day, each carrying two or three soldiers, with their warlike accoutrements: and he was told, that, on an emergency, they could double that distance without great inconvenience. These animals, however, were supported on choice and substantial food, though, in common with their kind, they were capable of enduring hunger. Thus it is satisfactorily established, that there is a particular breed or variety of the Arabian camel, of smaller size and greater speed than the common species.

Though the camel produces but one at a time, or rarely two, the care which is observed in their multiplication renders them numerous. A caravan will exhibit a thousand, nay, four or five thousand, collected together; and a single individual will be master of four or five hundred.

It is not in journies only that the camel is of such remarkable utility to its owner: it alike constitutes the sustenance, convenience, and riches of the barbarous nomadic tribes; and it is indispensible to the luxuries of the more civilized nations. Its flesh is agreeable food; the milk is salutary and restorative; and from its hair are manufactured valuable articles of clothing.

The camel annually casts its hair in spring; and in the space of three days is as bare as a sucking pig. During that interval, the keeper is careful to tar it over, in order to preserve it against the annoyance of the flies. But the colour and abundance of hair depend entirely on the particular species of camel, and the climate which it inhabits: that of the Arabian camel is thin and whitish; that of the Bactrian camel thicker and darker coloured. From the hair a coarse kind of clothing, almost impermeable by water, is made for camel-drivers and shepherds; and the same commodity, for an analogous purpose, is used as wrappers of merchandize long exposed to wet in heavy rains. But in Persia and the Crimea more valuable manufactures are produced in narrow cloths of different colours, and fine stockings, of which white are the highest priced. It is wrought into shawls, carpets, and coverings for the tents of the Arabs. According to Pallas, the Tartar women of the plains manufacture a kind of warm, soft, and light narrow cloth from the hair of the Bactrian or Tauridan camel, preserving the natural colour. The hair of different colours is an article of export from Asia and Africa: its value is proportioned to the fineness and colour, that which is black being the dearest.

Besides being employed in carrying burdens and for the saddle, camels are trained for draught. The opulent Tartars of the Crimea convey their families from place to place in large four-wheeled waggons drawn by camels; and in some countries still farther east, they are used in dragging heavy clumsy carts.

The camel lives between forty and fifty years, but it is not unlikely that the duration of its life is dependent on the treatment which it receives. Sanguine hopes of its naturalization in the warmer European climates have hitherto been disappointed; yet if the change could be gradually accomplished in only a few degrees of latitude to each succeeding generation, there would probably be a less effectual check to its propagation.

As Mahomet the prophet himself rode a camel, it is considered a sacred animal in the East, nor will his votaries at all times admit of its being devoted to the service of Christians. They seldom eat its flesh themselves, not so much from entertaining any scruples on the lawfulness of doing so, as from reluctance to sacrifice an animal so valuable to them; but where fanatacism prevails, selling it to Christians would be deemed profanation. After the annual pilgrimage to Mecca, the camel which carries the standard of Mahomet is ever afterwards exempt from labour, and the Mahometans even believe that it will participate in the pleasures of a future life.

Perhaps there is no animal of the same use to so large a portion of mankind as the camel; its sustenance is scarcely perceptible, its labours are unequalled, and it is besides an ample source, both of food and clothing. See Buffon *Histoire Naturelle*, tom. xi.; Russel's *History of Aleppo*, vol. ii.; Jackson's *Account of Morocco*; D'Obsonville *sur les Mœurs des Animaux*; Pallas, *Travels*, tom. ii.; *Philosophical Transactions*, 1791, 1806; Tavernier, *Voyages*, tom. i. p. 129; Denon, *Voyages dans l' Egypte*. (*c*)

CAMEL, in mechanics, the name of a machine which has been chiefly used by the Dutch, for raising or lifting ships by the buoyant power of water.

In the Zuyder Sea, opposite to the mouth of the river Y, there are two sand banks, between which is a passage called the Pampus, that permitted only small vessels to pass through: Vessels of a larger size took in the greater part of their cargo after they had passed this strait; but the sand accumulated to such a degree, that it became necessary to employ some mechanical method of carrying the Dutch vessels over this obstruction. In 1672, large chests, filled with water, were fastened to the bottom of the vessels, and when the water was pumped out of the chests, the ships were buoyed up, and enabled to pass the shallow. This simple and ingenious contrivance was obviously the origin of the camel, which was invented by Meuves Meindertszoon Bakker, a burgomaster of Amsterdam, in the years 1688 or 1690. A similar invention had been made several years before by Cornelius Meyer, a Dutch engineer, who went to Rome to clear the Tyber, and render it navigable; but it is not so complete a machine as that of Bakker, who is well entitled to be regarded as the original inventor.*

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* An account of Meyer's machine will be found in his book, entitled, *L'arte di restituire a Roma la tralasciata navigazione del suo Tevere.* Dell' Ingegniero Cornelia Meyer, Olandese. In Roma, 1683. Fol.

The camel, which we have represented in Plate CIX. Fig. 1, 2, and 3, consists of two similar hollow vessels, B, C, Fig. 1. constructed in such a manner that they can be applied on each side of the hull of a ship, as is represented in Fig. 3. Each of the hollow vessels B, C, are so formed as to resist the admission of water; and on the deck of each are erected a number of horizontal windlasses, *d*, *d*, *d*, &c. from which ropes *d e f* proceed through the tube *d e*, and being carried under the keel of the vessel, pass through similar tubes *d' e'*, from which they are conveyed to the windlasses *d' d'*, on the deck of the other half of the camel. When this machine is to be employed for the purpose of elevating a ship, the water is permitted to run into each half of the camel, till both the cavities are filled: the ropes *d e f*, &c. are then cast loose, and the ship is conducted between the two vessels B, C, and large planks are placed horizontally, so as to extend from the portholes of the ship, and rest upon the upper surface of the camel. The ropes *d e f*, &c. are then made fast by means of the windlasses *d*, *d'*, &c. till the ship is firmly united to the camel. The water is next pumped from the cavities of the camel, by means of the pumps *g*, *g*, till the buoyancy of the hollow vessels raises the ship from the sand, and enables it to surmount the obstruction. The length MN of the camel is generally about 127 feet; the breadth OP, of the one end 22 feet, and the breadth QR, at the other, 13 feet. The hollow part of the vessels B, C, is divided into several compartments. An East India ship that draws 15 feet of water, was so much elevated by means of this machine, that it drew only 11, and the largest ships of war in the Dutch service, from 90 to 100 guns, were always enabled to surmount the different sand-banks of the Zuyder Zee. These machines have been likewise used at Venice, and in Russia. For further information on this subject, see *L'Art de batir les vaisseaux*, Amsterdam, 1719; Leupold's *Theatrum Machinarium*, tom viii. § 180, p. 96, tab. 24; Wright's *Travels*; Muschenbroek's *Introduct. ad Philos. Natur.* vol. ii. p. 521. The engraving of the camel in Plate CIX., is, we believe, the first that has been given in any English work. (π)

CAMELINA, a genus of plants of the class Tetradynamia, and order Siliculosæ. See Botany, p. 258.

CAMELLIA, a genus of plants of the class Monadelphia, and order Polyandria. See Botany, p. 265.

CAMELOPARD. See Mammalia.

CAMEO, is the name given to stones of different colours, which contain sculptures in alto or basso relievo. The effect of nature is here combined with art, and the moderns have in vain attempted to imitate these relics of antiquity.

The onyx is a hard semipellucid stone, formed of several zones or strata of different colours closely united, and throughout blended together. As the colours are more distinct and opposite, the greater value is put upon the stone. Some species exhibit three colours, and in others only two are seen, of which the upper is of a beautiful white, on a ground of deep gray.

These two species of stone were selected by the ancients for engravings or sculptures in alto and basso relievo, as the colours would admit, or according to the choice of the artist, and the subjects represented were some of the most noted incidents in antiquity, such as the labours of Hercules, the rape of Proserpine, or the annunciation to Achilles of the death of Patroclus. But one chief excellence consists in the ground being absolutely opposite and distinct from the colour of the subject. Thus, a white figure appears in high relief, though the ground be of a deep shade, or even black; and the judicious arrangement of the parts, where uniformity of colour is required, most eminently displays the skill of the artist.

Genuine cameos always bear a high value, proportioned to the beauty of the execution and the quality of the stone. They are discovered in various countries, both in the natural state, and preserved from former times. Of late years, some very exquisitely finished have been recovered by Europeans who visited Delhi.

Though the moderns have been unsuccessful in sculpturing cameos, they have produced beautiful specimens of analogous workmanship in shells. There the interesting events of ancient history are in like manner chosen, and the relief is pure white, while the ground is blue. This invention is said to be of Sicilian origin.

Another method of imitating the cameos of the ancients has been practised with very great success. Pieces of coloured glass are put into a crucible, alternating with layers of chalk or Spanish white. The crucible is then placed on a fire, the heat of which increases gradually for three hours, till it becomes very intense. The pieces of glass then turn opaque without losing the original colour, and those pieces which have no colour at all will become milk white like porcelain. If the heat has been well regulated, and not raised too high, these opaque pieces of coloured glass may be soldered to one another, so as to imitate the differently coloured layers of the onyx. The coloured glass which is found in ancient churches, are sometimes only penetrated by the colour through half their thickness; so that when pieces of it are rendered opaque by the preceding process, the transparent part of it that was not penetrated by the colour becomes white, and two differently coloured layers are thus obtained, without the process of soldering. The white part of the glass is then ground down to the requisite thickness, and the figures are cut upon it either in alto or basso relievo by the common process.

If the subject to be engraved is only a simple head, it may be first cut out, and then fixed upon a piece of glass of a different colour. The head is first attached with gum to the piece of glass, and after the adhesion is sufficiently firm, the surface of the glass containing the head is laid upon a bed of tripoli, and pressed upon it as if a good impression of the head were required. The glass and the head are allowed to rest upon the tripoli till it is quite dry, and as soon as this happens, the whole is put into a furnace and exposed to an intense heat. The gum is then burnt off, and the head is soldered to the piece of coloured glass upon which it was placed. The hair of the figure may be afterwards coloured, by using a little of the solution of silver in the spirit of nitre, and again exposing the head to a proper heat. For further information on this subject, see *Essais sur L'Art des anciens, de joindre par le fusion deux especes de verre, pour le gravure en relief, par* M. Gerhardt, Conseiller Privé des Finances au departement des mines du Roi de Prusse. (τ)

CAMERA Lucida, the name of an instrument for enabling those who have no knowledge of the art of drawing, to take sketches either of natural or artificial objects. This ingenious and useful contrivance was invented in the year 1807, by W. H. Wollaston, M. D. Sec

R. S., a philosopher to whom science is indebted for numerous inventions and discoveries. As this instrument is of extensive use, its ingenious inventor has very properly secured the exclusive sale of it by patent. The description which Dr Wollaston has given of the Camera lucida is so short and perspicuous, that we shall make no apology for giving it in his own words.—We shall then conclude the article with an account of an instrument founded on the same principle.

"While I look directly down at a sheet of paper on my table, if I hold between my eye and the paper a piece of plain glass, inclined from me downwards at an angle of 45°, I see by reflection the view that is before me, in the same direction that I see my paper through the glass. I might then take a sketch of it; but the position of the object would be reversed.

To obtain a direct view, it is necessary to have two reflections. The transparent glass must for this purpose be inclined to the perpendicular line of sight only the half of 45°, that it may reflect the view a second time from a piece of looking glass placed beneath it, and inclined upwards at an equal angle. The objects now appear as if seen through the paper in the same place as before; but they are direct instead of being inverted, and they may be discerned in this manner sufficiently well for determining the principal positions.

The pencil, however, and any object which it is to trace, cannot both be seen distinctly in the same state of the eye, on account of the difference of their distances, and the efforts of successive adaptation of the eye to one or to the other, would become painful if frequently repeated. In order to remedy this inconvenience, the paper and pencil may be viewed through a convex lens of such a focus, as to require no more effort than is necessary for seeing the distant objects distinctly. These will then appear to correspond with the paper in *distance* as well as *direction*, and may be drawn with facility, and with any desired degree of precision.

This arrangement of glasses will probably be best understood from inspection of Plate CIX. Fig. 4. *a b* is the transparent glass; *b c* the lower reflector; *b d* a convex lens (of twelve inches focus); *e* the position of the eye; and *f g h e* the course of the rays.

In some cases a different construction will be preferable. Those eyes, which without assistance are adapted to seeing near objects alone, will not admit the use of a convex glass; but will, on the contrary, require one that is concave to be placed in front, to render the distant objects distinct. The frame for a glass of this construction is represented at *i k*, Fig. 6. turning upon the same hinge at *h* with a convex glass in the frame *l m*, and moving in such a manner, that either of the glasses may be turned alone into its place, as may be necessary to suit an eye that is long or short sighted. Those persons, however, whose sight is nearly perfect, may at pleasure use either of the glasses.

The instrument represented in that figure differs moreover in other respects from the foregoing, which I have chosen to describe first, because the action of the reflectors there employed would be more generally understood. But those who are conversant with the science of optics, will perceive the advantage that may be derived in this instance from prismatic reflection; for when a ray of light has entered a solid piece of glass, and falls from within upon any surface, at an inclination of only twenty-two or twenty-three degrees, as above supposed, the refractive power of the glass is such as to suffer none of that light to pass out, and the surface becomes in this case the most brilliant reflector that can be employed.

Fig. 5. represents the section of a solid prismatic piece of glass, within which both the reflections requisite are effected at the surfaces *a b*, *b c*, in such a manner that the ray *f g*, after being reflected first at *g*, and again at *h*, arrives at the eye in a direction *h e* at right angles to *f g*.

There is another circumstance in this construction necessary to be attended to, and which remains to be explained. Where the reflection was produced by a piece of plain glass, it is obvious that any objects behind the glass (if sufficiently illuminated) might be seen through the glass as well as the reflected image. But when the prismatic reflector is employed, since no light can be transmitted directly through it, the eye must be so placed that only a part of its pupil may be intercepted by the edge of the prism, as at *e*, Fig. 5. The distant objects will then be seen by this portion of the eye, while the paper and pencil are seen past the edge of the prism by the remainder of the pupil.

In order to avoid the inconvenience that might arise from an unintentional motion of the eye, the relative quantities of light to be received from the object, and from the paper, are regulated by a small hole in a piece of brass, which by moving on a centre at *c*, Fig. 6. is capable of adjustment to every inequality of light that is likely to occur.

Since the size of the whole instrument, from being so near the eye, does not require to be large, I have, on many accounts, preferred the smallest size that could be executed with correctness, and have had it constructed on such a scale, that the lenses are only ¾ths of an inch in diameter.

Though the original design and principal use of this instrument is to facilitate the delineation of objects in true perspective, yet this is by no means the sole purpose to which it is adapted; for the same arrangement of reflectors may be employed with equal advantage for copying what has been already drawn, and may thus assist a learner in acquiring at least a correct outline of any subject.

For this purpose, the drawing to be copied should be placed as nearly as may be at the same distance before the instrument that the paper is beneath the eye-hole; for in that case the size will be the same, and no lens will be necessary, either to the object or to the pencil.

By a proper use of the same instrument, every purpose of the pentagraph may also be answered, as a painting may be reduced in any proportion required, by placing it at a distance in due proportion greater than that of the paper from the instrument. In this case a lens becomes requisite for enabling the eye to see at two unequal distances with equal distinctness; and in order that one lens may suit for all these purposes, there is an advantage in carrying the height of the stand according to the proportion in which the reduction is to be effected.

The principles on which the height of the stem is adjusted will be readily understood by those who are accustomed to optical considerations. For, as in taking a perspective view, the rays from the paper are rendered *parallel*, by placing a lens at the distance of its *principal* focus from the paper, because the rays received from the distant objects are *parallel*; so also when the object seen by reflection is at so short a distance that the rays received from it are, in a certain degree, *divergent*, the rays from the paper should be made to have the same degree of divergency, in order that the paper may be seen distinctly by the same eye; and for this purpose, the lens must be placed at a distance less than its principal focus. The stem of the instrument is accordingly marked at certain distances, to which the conjugate foci are in the several proportions of 2, 3, 4, &c. to 1, so that distinct vision may be obtained in all cases, by placing the painting proportionally more distant.

By transposing the convex lens to the front of the instrument, and reversing the proportional distances, the artist might also enlarge his smaller sketches with every desirable degree of correctness, and the naturalist might delineate minute objects in any degree magnified.

Since the primary intention of this instrument is already, in some measure, answered by the *camera obscura*, a comparison will naturally be made between them.

The objections to the camera obscura are,

1st, That it is too large to be carried about with convenience.

The camera lucida is as small and portable as can be wished.

2dly, In the former, all objects that are not situated near the centre of view, are more or less distorted.

In this, there is no distortion; so that every line, even the most remote from the centre of view, is as straight as those through the centre.

3dly, In that the field of view does not extend beyond 30°, or at most 35°, with distinctness.

But in the *camera lucida* as much as 70° or 80° might be included in one view."

It is obvious, that the preceding contrivance may be applied to a telescope, for the purpose of taking sketches of the different objects that may be contained within the field of view; but as it is only a small portion of a landscape, or of any large object, that can be seen at once through a telescope, it would be desirable to have some contrivance by which the objects seen in different fields of view, and sketched upon the same piece of paper, might be all connected with each other into one landscape. This, however, can be done only to a certain extent, as will appear from Plate CIX. Fig. 7. Let AB be the direction of the telescope, which, when placed upon a suitable stand, can be moved round the axis O in a horizontal plane, $B\,b\,b'$; B, the extremity of the eyetube at which the prism of the camera lucida is fixed; MN, the paper, lying in a horizontal position; and $a\ b$, $a'\ b'$, successive positions of the telescope in a plane parallel to MN. Let EF be the field of view of the telescope, when seen on the paper by reflection from the prism; then the instrument must be so constructed, that when the telescope is in the position $a\ b$, and directed to the part of the landscape immediately adjacent to that which is contained in the field EF, the field of view FG, when seen by reflection from the prism, must be in contact with EF. When this happens, we have $B\,b = C\,c$, and the angle $BF\,b = EBF$, the angle subtended by the field of view; but it is obvious, that when the telescope is moved from the position AB into the position $a\ b$, its angular motion round O, viz. the angle $BO\,b$, is equal to the angle comprehended by the field of view, that is, to the angle BFE; therefore, in the triangles $OB\,b$, $BF\,b$, we have the angles at O and F equal, and the side $B\,b$ common, and consequently the side OB is equal to the side BC. From this it follows, that in order to have the successive fields of view EF, FG, GH, all joined to each other, or, at their proper relative distances, the distance of the eye from the paper must be equal to its distance from the centre of motion O, round which the telescope revolves. The telescope should therefore be placed upon a stand so constructed, that the centre of motion O may be placed in different positions between the eyepiece and the object-glass; by which means the observer may vary the distance of the paper from his eye, according as he wishes, to have his drawing on a large or a small scale. By the instrument when thus constructed, we are enabled to take a connected panoramic view of any horizontal zone of a landscape, whose breadth does not exceed the field of view of the telescope. The objects contained in the different fields of view, will be arranged in a circle whose diameter is equal to the distance of the eye from the centre of motion.

This instrument is admirably fitted for taking a correct outline of the visible horizon, with all the various indentations with which that line is generally broken by the intervention of valleys and mountains. Unless the horizon is extremely and unusually contracted, the field of view of a common telescope will contain a zone, which will easily comprehend every depression and elevation; and even when the place of the observer is embosomed in an amphitheatre of mountains which rise around him with various elevations, the field of view may be enlarged by diminishing the magnifying power of the telescope. For this purpose, the micrometrical telescope, invented by Dr Brewster, is particularly applicable, as the magnifying power can be increased or diminished, without changing any of the lenses; and as the distance between the eye and the centre of motion O, can be altered, even though the telescope is fixed to its stand.[*] The micrometrical telescope having also the properties of a compound microscope, any long object which cannot be contained in the field of view, in the direction of its length, may be delineated in a similar manner. This contrivance cannot be applied to the common compound microscope, as it has not a motion round an axis.

The camera lucida of Dr Wollaston might be fitted up with a horizontal motion, and without the aid of a telescope, so as to delineate one continued zone of a landscape; but when the objects are small, or at a considerable distance, a telescope becomes indispensably necessary. See the *Philosophical Magazine*, vol. xxvii. p. 343; Nicholson's *Journal*, vol. xvii. p. 1, vol. xxiii. p. 372, vol. xxiv. p. 146; and Brewster's *Treatise on New Philosophical Instruments*, Edin. 1812, book i. p. 11, book iii. p 133, and book vi. (o)

CAMERA OBSCURA. See OPTICS.

CAMERARIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 135.

CAMERARIUS, PHILIP, a learned author, who flourished in the sixteenth and earlier part of the seventeenth century. Camerarius is the same name as Chamberlain, one which is known over the whole continent, and evidently derived from the office of chamberlain to princes and religious houses.

Philip Camerarius was the son of Joachim Camerarius, a distinguished character of his time, who was regarded as among the most learned men in Europe. He was born in the year 1537, and called Philip after Melancthon the reformer.

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[*] The Micrometrical Telescopes, the property of which has been secured by a patent, are constructed and sold by Mr. W. Harris optician, London.

Philip Camerarius, at an early age, testified the same love of literature which has characterised other members of his family, and after receiving the instructions of his father, professedly studied the law. Having spent some years in this occupation, he left his native city Tubingen, and crossed the Alps to make a tour in Italy. An interesting fragment of a journal written on that occasion is preserved, which shews the state of the different places visited in his route, and proves that he possessed a mind capable of acute remark. The taste which he had acquired for the knowledge of the ancients, led him to those remains of antiquity which were most celebrated in history, and to cities such as Padua, Mantua, and Rome, which had given birth to eminent men.

The doctrines of the reformed religion had at that time made rapid progress in Germany, and the followers of Calvin and Luther were viewed with a jealous eye in countries subjected to the papal dominion. While Camerarius was walking the streets of Rome at mid-day with his companions, he was suddenly seized by the officers of justice, and carried to the prisons of the inquisition. Here he was confined a considerable time, and underwent repeated examinations concerning the religion he professed, the cause of his journey to Italy, and his acquaintance with certain individuals there. The fame of this sanguinary tribunal, and the danger of implicating the innocent, could not but fill both himself and his relatives with the most lively apprehension; though, by unusual good fortune, after the inquisitors having in vain endeavoured to make him a proselyte to the Roman Catholic faith, he was liberated. Being ordered to quit Rome, he repaired to his brother Joachim at Nuremberg in 1566.

Camerarius, after passing through some intermediate gradations, was promoted to be vice-chancellor of the university of Altorf in Franconia, and one of the state counsellors, offices which he filled with great applause during forty-two years.

At this time he was occupied, in conjunction with his brother, in editing the literary works of their father, which appeared in 1583 and 1585; and he was also engaged in the publication of his own writings. Of these, three volumes successively appeared under the same title, being *Operæ Horarum subscisivarum sive Meditationes Historicæ*, which contain a number of philosophical and critical remarks, though more the result of reading than of actual experience. This work being well adapted to the prevailing taste of the times, was translated into several foreign languages; but the doctrines it contains, being too liberal for a people enslaved by bigotry, an edict was published at Rome in 1603, prohibiting every individual from having it in his possession, under the severest penalties. After this it entered the *Index expurgatorius, librorum prohibitorum.*

Camerarius was also occupied in corresponding with his learned cotemporaries, such as Ritterhusius, Grynæus, Languetus, Hotomannus, and others; and in his literary pursuits, he, at great expence, collected an extensive library.

At length, in the full enjoyment of public and private estimation, he died in the year 1624, aged 87. An epitaph, written by himself in these words, is remarkable for its simplicity: "*Alii forsitan alia, nos nihil aliud.*" See Schelhorn *de vita, fatis ac meritis Philippi Camerarii*, 1740; and Camerarius *Relatio de Captivitate sua Romana.* (*c*)

CAMERONIANS, a Presbyterian sect in Scotland, which arose in the persecuting times of Charles II. They derived their name from one Richard Cameron, a young clergyman, who, having received ordination in Holland, where he had gone previous to the affair at Bothwel, returned to his native country, became a zealous and a popular field preacher, took an active part in the opposition, which was then made to the oppressive measures of the king, and was at last killed, along with several of his adherents, in an engagement which took place between them and the royal troops at Airsmoss, in the year 1680. When government found, that the Presbyterians could not be subdued into conformity, by the harsh and tyrannical measures which had hitherto been employed, it was agreed to attempt the same object by gentle methods; and for this purpose, an *indulgence*, as it has been called, was granted by the king's authority, in 1669, to such of the ejected ministers as had "lived peaceably and orderly." They were allowed to return to their respective parishes, and exercise their professional functions; and patrons were at liberty to present them to vacant churches. But the act was clogged with certain reservations and restrictions, which rendered the indulgence very disagreeable to men of scrupulous consciences. A second indulgence was issued by the lords of council, in 1672, holding out similar liberties, and qualified by similar conditions. Of these acts many took advantage, without feeling themselves chargeable with any violation of their covenant engagements. Many, too, who considered them as an encroachment on their religious rights, accepted of the boon which they offered, with a declared exception to their legality, and satisfied themselves with giving an open testimony against the Erastian power, exhibited in the acts of the council, and the ecclesiastical supremacy which had been exercised by the king. There were several, however, who peremptorily refused compliance upon any terms, and resisted every effort that was made to procure their submission. These were the persons afterwards denominated Cameronians. They conceived that such compliance necessarily involved an acknowledgment of the power, which the civil rulers claimed to give or withhold at pleasure their unalienable privileges, and consequently a dereliction of those principles which they were bound to maintain, both from a regard to Christ, the only head of the church, and from a regard to the solemn vows which they had taken before the world; and therefore they determined, whatever might be the consequences of their conduct, to separate from their conforming brethren, and struggle with the hardships and difficulties of their situation, till Providence should bring them deliverance. To the persecution, which, in consequence of their disobedience, they had reason to expect, they were soon subjected. The most arbitrary and vexatious proceedings were instituted against them. And such oppressions were practised, and such punishments inflicted, as were sufficient to instigate and to justify that rebellious spirit, which they afterwards displayed. It is very easy, as it is very common, to stigmatise these people with the epithets, fanatical and seditious; and it is not to be denied, that, in some instances, they went farther than either prudence or duty could warrant. But if we say this of men who were comparatively unenlightened, whose consciences were insulted in the nicest points, and who were hunted like beasts of prey, because they would not become the worst of slaves to the worst of masters, what language should be held with respect to the rulers whom they opposed—rulers who, by deeds of folly, injustice, and inhumanity, the most abominable in our national records, drove them into extremities, which they would otherwise have abhorred, and by which they must have been more certain of entailing misery upon themselves, than of giving any serious uneasiness to their oppressors? The Cameronians undoubtedly were intolerant, and gave harsh names and illiberal treatment even to the Presbyterians, whose general sentiments corresponded with their own, but from whom they found it necessary to separate. The charge of intolerance, however, should not be brought against them, by the admirers of Charles or of James. Their violent attachment to the *reformation rights* and the *solemn covenants*, may appear, to superficial thinkers, an expression of great weakness and ignorant zeal; but a very moderate attachment to these objects, which certainly contained the leading principles of liberty, was at that period equivalent to no attachment at all; neither indicative of sincerity, nor fitted to accomplish any substantial good. And, however much some of us may condemn, and others of us lament their excesses, both in doctrine and in practice, it is not very difficult to trace some connection between those very excesses, and the religious liberty which we enjoy—a connection well calculated to soften our censure, and diminish our regret.

The Cameronians became more united, systematic, and explicit in their views, in the year 1680; and in the following year, they began to form themselves into societies, and to have quarterly, or more frequent meetings, as circumstances permitted; and took the name of *The Societies United in Correspondence*. A paper was found on Mr Hall of Haughhead, at Queensferry, (called from that the Queensferry Paper,) containing the principal tenets of that sect; but containing also some expressions and sentiments, to which as a body they did not give their assent. They particularly disavowed the assumption of magistratical authority, to which the authors of it had ventured to lay claim. The tenour of this paper, and the conduct of a few people in attempting to rescue Mr Hall, provoked the council to issue a proclamation, granting power, among other things, to seize suspected persons, and mentioning Mr Richard Cameron and others by name. These having now completely broken off from the rest of the Presbyterian ministers and others, who would not adopt their peculiar notions, met in arms at Sanquhar, and published a declaration or testimony, in which they disowned the king's right to the crown and government of Scotland, and protested against the succession of James, on account of their popery and breach of covenant to God and the church. Mr Richard Cameron wrote a vindication of this paper, and a keen and lengthened controversy took place. The rejection of the royal authority, thus broadly and boldly avowed, is that part of their conduct, which has given the chief handle to the opponents and enemies of the Cameronians. Even some of their own number were dissatisfied with the language of the *Sanquhar Declaration*; and afterwards they amended and explained certain parts of it, while they defended it in general, in their *Informatory Vindication*, drawn up by Mr Renwick in 1687. Besides that declaration, Mr Cameron and about thirty others composed and subscribed a bond for their mutual defence. Very soon after this, the rencounter at Airsmoss happened, when the Cameronians were defeated, and Cameron and many more killed. In the course of the year, those who had been made prisoners in that engagement were executed as traitors. And a very strict search was made for the followers of Cameron throughout the country, some of whom were taken, and put to death for their non-conformity and rebellion. For a long while these unfortunate people were the objects of persecution and vengeance. No pity was shewn to age or sex—to character or condition; and government seemed resolved to demonstrate to the world, that they did not in any measure deserve the allegiance which they so rigidly demanded, and for withdrawing which the Cameronians were so severely punished. It is unnecessary to give an account of the sufferings which they endured, from the resentment and cruelty of their rulers. In 1686, there were some divisions among them. A considerable number disapproved of the violence of Mr Renwick, who was now at the head of the party; and not only separated from them, but published testimonies against some of their proceedings. The great point of difference seems to have been, that the former would not unite with such of the suffering Presbyterians as did not go all lengths with them, while the latter acted on more liberal principles, and were for associating with all who held the same general sentiments, and were in the same distressful circumstances. It was on this occasion that the Informatory Vindication was drawn up. In 1688, Mr Renwick, who appears to have been a pious worthy man, was seized, tried, and executed at Edinburgh. He died in the avowal of those doctrines, respecting the authority of the king, which he had hitherto maintained. He was the last who suffered publicly for the cause of religion. The revolution put an end to the calamities of the Cameronians, as it put an end to arbitrary sway, and to persecution for conscience sake. The Cameronians still exist as a distinct sect; but they are as inconsiderable in numbers, as they are decent and peaceable in their deportment. See Wodrow's *History of the Sufferings of the Church of Scotland; Hind let Loose;* and Burnet's *History of his own Times*. (*τ*)

CAMILLUS. See Rome.

CAMOENS, Luis De, the epic poet of Portugal, was born at Lisbon in 1517. His family was of considerable note, and originally Spanish. His misfortunes began early in life. In his infancy, his father, Simon Vaz de Camoens, commander of a vessel, was shipwrecked at Goa, where, with his life, the greater part of his fortune was lost. His mother, however, provided for his education at the university of Coimbra; where, in spite of Voltaire's rash assertion, that his youth was spent in idleness and ignorance, it appears from his works that he must have imbibed the matter as well as the spirit of classical learning. When he left the university, he appeared at the court of Lisbon, and mixed in its fashionable intrigues; but his personal beauty, his ardour and accomplishments, are supposed to have tempted him to amours above his rank, for he was banished from court; and as he has ascribed, in his poetry, the misfortunes of that period of his life to love, he is conjectured, like Ovid, to have cherished the passion too ambitiously.

He retired from court to his mother's house at Santarene, where he began his poem on the discovery of India, but quitted his retirement to join an expedition which sailed from Portugal against Ceuta, in Africa. In a naval engagement with the Moors in the Straits of

Gibraltar, he lost an eye, but distinguished his bravery so much in this and other actions, that he was recalled to court. From thence he was chaced once more by the characteristic jealousy of his countrymen, who still dreaded poetic gallantry amongst the court ladies, though his countenance had been so sadly marred.

In 1553, he sailed to India, with a resolution never to return, and little foreseeing the evils that were to shake that resolution.

When he arrived in India, an expedition was ready to sail to avenge the King of Cochin on the King of Pimenta. Without any rest on shore, he joined this armament, and in the conquest of the Alagada islands, displayed his usual bravery, not forgetting his duty as a poet, to celebrate the victory.

In the year following, he attended Manuel de Vasconcello in an expedition to the Red Sea. "Here," says Faria,* "as Camoens had no use for his sword, he employed his pen." Nor was his activity confined to the fleet or camp. He visited Mount Felix, and the adjacent inhospitable regions of Africa, which he so strongly pictures in the Lusiad, and in one of his little pieces, where he laments the absence of his mistress. When he returned to Goa, he had tranquillity to resume his great poem, but imprudently he stept out of the epic strain to indulge in satirizing the viceroy Francisco Baretto, by whom he was banished to China. Even in exile, however, he still found friends, and his talents made him useful. He was appointed commissary of the estates of the defunct in the island of Macao, where he continued for several years, proceeding with his Lusiad, and acquiring a small fortune. This fortune he unhappily lost on his return to Goa, by the permission of a new viceroy. He was shipwrecked in the gulf, near the mouth of the river Mecon, saving only his poems, which he held in one hand, whilst he saved himself with the other. At last, reaching Goa, he found a friend in the new viceroy, Don Constantine de Braganza. Still, however, the fate of the poet seemed to be

> "Marking each change of place with change of woe."†

A new governor succeeded Constantine, who suffered Camoens to be thrown into a common prison, on a charge of misconduct in the commissariat of Macao. He fully acquitted himself at a public trial, but was detained in confinement by his creditors till the gentlemen of Goa set him at liberty. He now resumed the profession of arms, and attended Don Pedro Baretto, who went as governor to the distant and barbarous settlement of Sofala. A ship bound homeward having touched at this place, Camoens determined to return in her to Europe. He was detained for a while by the governor, on a mean charge for the hospitality he had received at his table. Two friends of the poet paid the pitiful demand; and thus, says Faria, Camoens and the honour of Baretto were sold together. ‡

He returned to Lisbon after an absence of sixteen years, unfortunate even in the time of his arrival, when the pestilence raged in the city, which prevented the appearance of his poem for three years. At last the Lusiad was printed in 1572. It is not certain whether he ever obtained a pension from Sebastian, then the sovereign of Portugal. If he ever did, it was but a small one, and was probably revoked by Cardinal Henry, who succeeded Sebastian. The latter prince was young and illiterate, and more capable of enjoying the sports of the field than the beauties of poetry. But though the story of the pension is doubtful, and is said to have been held on condition of the poet's residing at court, an expence which the sum would not afford, it is not more wonderful that the young king should be sensible of the honour bestowed on him by Camoens in his address at the opening of the first, than that a bigot like Cardinal Henry should neglect the greatest genius of his age and country. Henry patronized learning indeed, at least what was called learning by the monks and friars. They transmitted to him all their childish forgeries of inscriptions and miracles. This same Henry was the persecutor of George Buchanan; the patron of the Inquisition, of which he extended the horrors even to Goa in the east. Under his weak and wicked hands, the kingdom fell into utter ruin. When we find Camoens exhorting, in his patriotic poetry, young Sebastian, this priest-king's predecessor, to exclude the clergy, by which he meant, in the first instance, Cardinal Henry, from state affairs; when we look to the man of genius neglected by this worthless sovereign; traduced by his monkish contemporaries; yet, in his old age and misfortunes, lamenting less for his own fate, than for the approaching ruin of his degenerate country, —Camoens, with these worthy sentiments, and this unworthy destiny, commands an elevated and respectful sympathy. It is not merely the old man, or even the neglected man of genius dying in an hospital—it is the patriot and the patriot bard—the hero and the soldier—the friend of truth, as well as the enchanter of fiction, ennobling even his death upon a flock-bed, by those sentiments, which deepen, by contrast, the disgrace and degeneracy of his country. "I am ending (he says in one of his letters) the course of my life—the world will witness how I have loved my country." By some, it is said, he died in an alms-house. It appears, however, that he had not even the certainty of subsistence which those houses provided. He had a black servant who had grown old with him, and who had long experienced his master's humanity. This grateful Indian, a native of Java, who, according to some writers, had saved his master's life in the unhappy shipwreck, where he lost all his effects—this Indian, grown old and white haired in his service, begged in the streets of Lisbon for the only man in Portugal on whom God had bestowed those talents which have a tendency to erect the spirit of a downward age. He died in the year 1579, in his 62d year.

While Trissino, says Voltaire, was clearing away the rubbish in Italy which barbarity and ignorance had heaped up for ten centuries in the way of the arts and sciences, Camoens, in Portugal, steered a new course, and acquired a reputation which lasts still among his countrymen, who pay as much respect to his memory as the English to Milton. This criticism, though true as it respects Camoens, is quite French with regard to Trissino. Ariosto did a thousand times more to restore poetry in Europe than Trissino, who wrote a heavy poem in strict imitation of the ancients, intended as an antidote to the magic wonders of the bard of Reggio. But it did not succeed; and Tasso, who made the ancients more expressly his models, was still obliged to adhere to the *speciosa miracula* of the fabulous school.

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* Quoted by Mickle.

† Falconer's Shipwreck.

‡ If we could fancy a man to start from the grave to deny an act of meanness, the disgrace of this meanness might awaken Baretto. Let us hope, in charity, what is seemingly hinted at by the biographers of Camoens, that the Governor of Sofala only used this pretext of debt, as the means of keeping Camoens to be an entertaining companion in a desert station. If this creditor of the poet could have foreseen the look of contempt on every human brow that was to read, through succeeding ages, this story of his demand, can we believe that, allowing him to be the veriest wretch, he would have taken, as board wages for his guest, all the gold of the Indies?

The able translator of the Lusiad, Julius Mickle, has indignantly spurned at the charge of incongruous machinery which Voltaire brought against the Lusiad. Voltaire, as an instance of this, quotes the passage where Gama, in a storm, addresses himself to Christ, and where Venus comes to his relief. "There is no such passage," answers Mickle, "in the Lusiad. Gama, in a tempest, prays to the Holy Power, to whom nothing is impossible—the Sovereign of earth, sea, and land, who led Israel through the waves; who delivered Paul, and who protected the children of the second father of the world from the deluge: but Christ is not once mentioned in the whole passage."* Bacchus and the Virgin Mary, adds the Frenchman, are very naturally found together. If words have meaning, answers Mickle, this informs the reader that they are found together in the Lusiad; yet the truth is, in the whole poem there is no such personage as the Virgin Mary.

It is true that Mickle has exposed several glaring instances of ignorance and misrepresentation in Voltaire's critique; his mention of Emanuel II. of Portugal, for instance, and his notion of the poet having actually sailed with the discoverer of the passage to India. It is true, also, that whenever a good joke was in view, especially if the Virgin Mary could be included, our French philosopher was generally seized with *a shortness of truth.* But if we look to Mickle's vindication of the Portuguese poet's machinery, it is not satisfactory. Gama prays to the Sovereign of Earth and Heaven, who delivered Paul and the children of Israel. It is needless to tell us that this is the Jupiter Optimus Maximus—the Great Philosophical Jove, "adored by saint, by savage, and by sage." It is the living and true Deity of the Bible; and being such, Venus (though we should call her the celestial Venus, and the great principle of love) has nothing to do where such a sacred name is implored. The criticism of Voltaire still remains unanswered: that the hero and the object of the enterprize being Christian, Heathen deities are improperly introduced. His translator contends, that whatever may be said against the ancient machinery in a modern poem, candour must confess that the allegory of Camoens, which arms the genius of Mahommedanism against the expedition of his heroes, is both sublime and most happily interesting. The genius of Mahommedanism, we cannot but remark, had no motive to oppose the success of Gama and his followers, unless it was to oppose the progress of Christianity.† Had the political genius of Asia been alarmed and brought into action, the poet might have supposed his readers to forget the religion of Europe; but when the *religious* genius of Asia is brought forward as an agent in the poem, it is needless to excuse Camoens, by alleging, that Christ is not mentioned; the Christian religion is irresistibly brought to our recollection; our hopes are awakened for the success—our fears for the misfortunes of its cause. How much more consistent is the machinery of Tasso, who leads our imagination to blend the interests of witchcraft, Paganism, Mahommedanism, and hell itself, in one common view, as opposed to the cause of Christianity. This is a great and consistent machinery, finely copied by Milton, who identifies the Pagan deities, and the infernal cherubs and seraphs, and thus clothes himself in the spoils of superstition. On the whole, the defence of Camoens for his Venus, Mars, Neptune, and Jupiter, though ingeniously pleaded by Mickle, is not made out. It is a maxim in law, that the *inscientia legis* is not an apology for delinquency; and all that can be said for Camoens is, that he knew not the law of consistency.

Another objection to the Lusiad, very generally adduced, is the baldness and want of elevation of the style. This Mickle has strenuously denied, and insists, that an uniform simplicity and manly diction characterises the Portuguese epic. This question we ought to leave Portuguese scholars to decide; observing, at the same time, that the translator's ornamental diction is not a proof of such a fault in the original. English poetry was in a high state of artificial efflorescence when Mickle wrote, and he might find or deem it impossible to arrest the public attention by a faithful adherence to the primitive simplicity of his author. Mickle has also added considerably to the outlines of the very story of the poem. In so doing, he has been generally commended by the best judges. This we think a more conclusive circumstance against Camoens. The colour of a poem may require heightening in passing from a simpler to a more refined language; but the form and substance of a story we should suspect to be defective, which needs addition to make it interesting in any transmission.

Paradoxical as it may seem, it has been said, perhaps with more truth of the Lusiad than of any other epic, that its defects prove its beauties, since the attractions of the poem have prevailed to render it popular in spite of those defects. The Lusiad abounds with pictures of manners, from th[illegible] the highest chivalry to those of the rudest, fiercest, and most simple barbarism. The characters are strongly sketched; the heroism of Gama and of his friend Monzaida (the Achates of the Lusiad), are nobly contrasted with the base, selfish, and perfidious portraits of the Zamorim and the Moors. To the manners of the piece, the novelty of fire-arms is also added; and this artificial trait in the modern materials of a battle, is introduced with a most dignified and dexterous simplicity. The island of Venus of Camoens furnished to

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* The Messiah, however, and the Catholic faith, are abundantly mentinned throughout the Lusiad.

† Mickle justifies this allegorical machinery by the Henriade; but this against Voltaire is merely an *argumentum ad hominem.* Allegory under any form, but most of all under Pagan names, is unfitted to support a modern epic poem. It is in vain that Boileau tells us—

> Chaque vertu devient une divinité:
> Minerve est la Prudence, et Venus la Beauté.
> Ce n'est plus la vapeur qui produit le tonnerre
> C'est Jupiter armé pour effrayer la terre.
> Un orage terrible aux yeux des matelots,
> C'est Neptune, en courroux, qui gourmande les flots.
>
> L'Art Poetique, Chant 3me.

Tasso the prototype of his enchanted forest, as the garden of Armida furnished our Spenser with his bower of bliss. In this part of his poem he is alike rich and original. The apparition which, in the night, hovers athwart the fleet near the Cape of Good Hope, is one of the grandest of poetical fictions, and the invention is completely his own. We subjoin the translation:

—— "Rising through the darken'd air,
Appall'd, we saw a hideous phantom glare;
High and enormous o'er the flood he tower'd,
And 'thwart our way with sullen aspect lower'd.
An earthy paleness o'er his cheeks was spread;
Erect uprose his hairs of wither'd red.
Writhing to speak, his sable lips disclose,
Sharp and disjoin'd, his gnashing teeth's blue rows;
His haggard beard flow'd quivering on the wind;
Revenge and horror in his mien combin'd.
His clouded brow, by withering light'nings scar'd,
The inward anguish of his soul declar'd.
His red eyes glowing from their dusky caves,
Shot livid fires:—far echoing o'er the waves
His voice resounded; as the cavern'd shore
With hollow groan repeats the tempest's roar."

(*n*)

CAMP. See Castrametation.

CAMPAGNA di Roma, formerly *Campania*, is a province of Italy, which comprehends the greater part of ancient Latium. It is bounded on the north by Sabina; on the east and south east by Abruzzo Ultra, and Lavoro; on the south west by the Mediterranean; and on the north west by the Patrimony of St Peter.

The Campagna di Roma, which is about 45 miles broad in almost every direction, is, as its name denotes, a flat and level district, interspersed with but few elevations. In approaching Rome from the north, the sky-line towards the south and south-west has the appearance of one uninterrupted level, except where the dome of St Peter's rises majestically above the horizon, and indicates, at the distance of many miles, the position of Rome. The soil of the Campagna is wholly volcanic, and seems to be composed chiefly of the detritus of pumice-stone. It is generally dry, but wherever there is moisture, the vegetation is very luxuriant.

The elevations of the Campagna, to the south of the Tiber, have commonly the form of great waves, whose summits are very distant from each other, and the intervals between these elevations are valleys which drain to the Tiber or to the sea, and form the richest meadows. These elevations are all volcanic, [illegible] have a nucleus of hard stone, called *peperino*, or *tuffa*, which appears to be only the volcanic matter in a state of higher induration. These hills are pierced in every direction by caverns; and M. Bonstetten, who examined this part of Italy with the greatest care, affirms, that he never could find a rock without numerous excavations. Many of them, which were inhabited by robbers, have been shut up by the police, and others have been concealed by the falling of the earth. These caverns, in which no marks of fusion appear, are almost always round, though they sometimes pass through rocks in a cylindrical form. Some of them in the neighbourhood of the famous brook of Cremera, are of a singular structure. Beds of small calcareous stones are found in the volcanic matter; and all the hills in the neighbourhood are pierced with caves of a similar structure, which have been used as prisons or tombs. Bonstetten endeavours to explain these appearances, by supposing that the whole of Latium was formerly a gulf of the sea, which extended to the base of the mountains of Sabina, and that the pebbles were stratified at the time when the submarine volcanoes were in action. "Toutes ces cavernes prouvent que les eaux qui ont stratifié ces galets ont fait leur ouvrage dans le tems des volcans, qui melant leur ejections parmi les depots des fleuves, ont enfin fait sortir de la mer le sol de cette Rome, destirée comme les volcans dont elle est issué, a devenir le foyer d'autres bouleversemens."

The highest eminence in the Campagna is Monte Albano, now Monte Cavo, which is about six leagues from Rome, and rises about 2920 feet above the level of the sea. It is united at its base, on one side, to the Algidus of the ancients; and on the other, to Monte Velletri, and forms an immense insulated mass, situated on an extensive plain, and almost at an equal distance from the sea and the calcareous mountains of Sabina. A chain of hills surrounds the base of Monte Cavo; and on the tops of those which encircle the northern side of its base, are placed the villages of Compiti, Colonna, Monté, Porcia, Frascati, Rocca-di-Papa, Marino, Castel Gandolfo, Albano, Larriccia, Gensano, and Citta Lavigna. This mountain is composed of volcanic ejections, and the Rocca-di-Papa consists of tuffa.

Mount Soracte, which is about eight leagues north-east of Rome, is completely insulated, and rises to the height of about 2119 feet.

The next principal eminence in the Campagna, is the Villa Millini, which is placed on the summit of Monte Mario, about half a league to the north east of Rome. Its height, above the level of the sea, is 440 feet, and as it occupies the centre of the great plain, it commands a most extensive view of the Campagna. The rock of which it consists, is filled with shells, but is slightly indurated, and the base of the hill rests on the volcanic matter which surrounds it. Bonstetten supposes that Mount Albano and Soracte have both a calcareous nucleus below the volcanic matter, and that the whole base of the Campagna is likewise calcareous. As a proof of this, he mentions that in the Grotto del Mondo, at Tivoli, large calcareous stones are found embedded in the volcanic ejections which form the vault of the caverns. The great plain of Rome is completely free of stones, and those which do occur are either brought there by the hand of man, or detached from some neighbouring volcanic rock. The streets of Rome, and all the ancient roads, are paved with hard lava; and it is only on the side of Palestrina, the ancient Preneste, that calcareous stones appear in the volcanic soil.

The volcanic ejections seem to have had their principal direction from north to south, since Monte Cavo, the highest elevation, is entirely enveloped, while the Villa Millini is scarcely covered; and on the calcareous hills to the east the volcanic soil terminates at the height of 30 or 40 toises above the plain.

A ridge of hills raised about 300 or 400 feet above the level of the sea, stretch in a direction parallel to the coast, from the Tiber to Torre St Lorenzo, beyond Ardea. The tongue of land which lies between this range and the sea is entirely formed by the alluvion of the Tiber and of the sea, which throws back upon the land the sand which is carried down by the river. The whole of the country, which was the ancient Laurentum, is extremely fertile, and the climate very temperate.

Though different travellers have pointed out craters in various parts of the Campagna, yet there appear to be only three which are characterised with sufficient distinctness. The first of these is the famous lake Regillus, which is about a quarter of a league in diameter. It is placed at the bottom of an inverted cone of hard black lava, from forty to sixty feet high, which forms bare and rugged rocks, and is entirely open on the side of the road where the lake is level with the plain. This crater is not like those of Albano and Nemi, covered with volcanic ejections which take away from it the regular form of an inverted cone; but the lava is almost completely uncovered in its upper part.

The two other craters of Albano and Nemi are about four or five hundred feet higher than that of lake Regillus. They are covered with volcanic ejections several hundred feet in height, which prolong the cone from the hard lava which forms the basins of the lakes. These two craters are of a very regular conical form, and so extremely high that it requires half an hour to ascend from the lake to the top of the higher cone. The famous emissary made at the siege of Veii, is cut precisely between the volcanic ejections, which are easily pierced, and the hard lava which now contains the remaining waters of the lake. When the lake occupied the higher part of its extensive basin, the immense mass of waters which it contained were in danger of overwhelming the rich plains below. The wealthy citizens of Rome, alarmed for the destruction of their fields, are said to have made use of the siege of Veii as a pretext for employing the people, or a part of the army, to cut the emissary, by which the superabundant water was discharged.* The crater of Nemi is a very little smaller than that of Albano, but is equally regular and picturesque. Its cone does not appear to have been at any time entirely filled with the water of the lake. The lava in the Campagna is every where of an uniform hardness and appearance; and wherever it appears, it is covered with volcanic ejections.

There are numerous sulphureous springs in the Campagna, but the most abundant of these is between Tivoli and Rome, where the water comes out of the ground almost boiling hot, and forms the lake of Solfatara. The reeds and other vegetables are so incrusted with calcareous depositions, that they have the appearance of stone, and islands of a considerable size, which are formed by them, float about the lake, and are capable of carrying several people at a time. The stream issuing from this lake has the same property, and continues to smoke till it joins the Anio or the Teverone. The Anio possesses a similar property of forming calcareous depositions of every shade, from the brilliant crystallisations, which are called *confetti di Tivoli*, to the darker concretions, which have incrusted a forest very near Rome. Near Subiaco the minutest insects, and the leaves of the vine, are distinctly seen in these incrustations. After the Anio has passed the fine cascades of Tivoli, it forms, by depositions in the great plain, those immense beds of *travertino*, of which St Peter's, a part of the Colliseum, and all the other public edifices in Rome are built. There are likewise several springs of acidulous water without any sulphur, as at Aqua Acetosa.

The Campagna contains 112,909 rubbias (a rubbia of land contains 4866 square toises) or 940 square miles, of 74 to a degree. About two fifths of this land belongs to the church, and the other three fifths to about a hundred lay proprietors. The farms are held by leases of nine years, and also by perpetual leases; but the last of these leases is abrogated, if the farmer neglects for two years to pay his rent. The general price of a rubbia of good land is about twenty piastres, and the expense of cultivating it amounts to about forty piastres.

	Piastres.
Six labourers, estimated at - - -	14
A rubbia† and half of seed - - -	12
Manure - - - - - - - -	5 50
Reaping, carting, and thrashing - -	8 50
Total expence -	40

Before the revolution, a rubbia of corn was sold at six or eight piastres; but in the year 1802, the price varied from 22 to 30 piastres.

The ground is sown every third year. During the first year it lies in fallow. It is laboured the second year, and the third year it produces a crop. The soil is wrought six times; the first operation is called *rupitura;* the second, which ought to be a foot and a half deep, is called *reconditura;* the third, *refenitura;* the fourth, *rinquartatura;* the fifth, *rifrescatura;* and the sixth, *sematura.* From the great quantity of rain which falls, particularly in the southern part of the Campagna, and from the rapidity with which it descends, the greatest care is taken to carry it off the fields. In every field there are three kinds of ditches, viz. small parallel ditches called *liræ* by the ancients, and placed at the distance of three feet. These are traversed by wide ditches, placed at a greater distance, and large canals, called *colliquiæ*, carry off from these the superfluous water.

Excellent fruit, vegetables, and almost every species of grain are produced in the Campagna. Extensive plantations of Turkish wheat grow in the lower grounds, it rises to a considerable height, and is used for various purposes. The stalks of it form canes for the support of the vines, and are also used in the construction of cottages; the leaf is employed for thatching them, and likewise for mattrasses, and the flour composes various dishes, which are eaten by all ranks, and are regarded as particularly wholesome and nutritive.

The large reed, (the *arundo donax*), which rises to the height of twenty feet, is cultivated with great advantage. Oxen and asses feed upon the leaves of it: It forms an admirable support to the vines in a country not much exposed to violent winds, and after having served this purpose it is still useful for burning. That part of agriculture which relates to the breeding of cattle is completely neglected in the Campagna. M. Bonstetten observes, that at Torre-Paterno, within seven leagues of Rome, he saw a herd of several hundred cows, which the farmer would not take the trouble of milking, though milk is as dear at Rome as in any of the other large cities of Europe. The great defect, however, in the agricultural operations of this and other parts of Italy, arises from the total want of judgment which is displayed in the application of the soil. Vineyards are planted in the most fertile and best watered land, which is particularly fitted for the growth of corn. Corn is sown in land which is particularly adapted for the vine; and wood is planted in the finest meadows, while the ground fit for wood is not used at all. "J'ai vu des champs," says Bonstetten, "escarpès et pierreux

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* This work was executed in the year of Rome 358.

† A rubbia of corn weighs 640 pounds French of 12 ounces.

cultivès en ble, qui rendent à peine deux pour un, tandis que la vigne etoit placée dans le terrain le plus gras et le mieux arrosé, et que le tiers du betail avoit peri de faim faute de foin pour le nourrir pendant quinze jours de neige."

On the day of St Lawrence, (the 10th of August,) when the harvest is completed, and when the heat is generally greater than in any other season of the year, the inhabitants begin to burn the stubble, the ashes of which is almost the only manure which is employed. As the crops of grain grow to a considerable height, the reaper never stoops, but takes off the head and about a foot and a half of the stalk, and thus leaves the stubble about two or three feet long. After the conflagration is over, numbers of snakes, of a large size, are scorched to death, and others are choked, in attempting to cross the dusty roads, in order to escape from the fire. The smoke from the burning straw is extremely offensive to the traveller; and it not unfrequently happens, that the hedges or forests are burnt down by the flames.

The very small number of farm houses which exist in the Campagna, are miserable dwellings, built as appendages to old towers or temples, and are constructed out of the fragments of these ancient edifices. The inhabitants of these wretched hovels are compelled to desert them in the middle of summer, when fevers and agues prevail in the country; and they sleep either at Rome under the porticoes of the palaces and public buildings, or in the towns which are nearest to their farms. If they remain too long in the country, they are seized with the diseases which we have mentioned; and in the month of July, August, and September, the great proportion of patients in the Roman hospitals are the peasants from the surrounding country.

It appears from the testimony of Strabo, Pliny, Varro, and other ancient authors, that the air of the Campagna was formerly very salubrious except in a few places near the sea, where the soil was marshy. The unwholesomeness of the climate is said to have commenced about the sixth century, and to have arisen from the overflowing of the Tiber, in consequence of the accumulated rains by which it was raised above its former bed. It does not appear, however, from the best observations, that the bad air (*cattiva aria*) of the Campagna is owing to the stagnant water arising from the inundations of the Tiber, for it is chiefly in spring, in the time of the greatest drought, and in the months of August and September, long after the inundations of winter, that the bad air prevails. When the first rains of autumn succeed to the great droughts, the bad air completely disappears. On the Rocca di Papa, and on one side of the plain of Tivoli, the bad air is never experienced; but at different heights below this line, it seems to be equally prevalent. In 1775, the heights of Trinita del Monte were reckoned out of the reach of the bad air, but in 1802 they were completely under its influence.

The Pontine marshes which lie at the southern boundary of the Campagna are so extremely insalubrious, that it is dangerous even to travel through them in summer and autumn. Various attempts have been made by the popes to drain this unwholesome tract. "Pope Pius. VI. at a great expence," says an anonymous author, "converted a very considerable part of these pernicious marshes into pasturage, corn fields, and rice plantations. He made a canal 20 miles in length, which conveys the once stagnant waters into the sea; and he intersected it with many lesser channels, which direct them so as to fertilize the fields, which they once rendered useless and pestilential." It appears, however, from the observations of M. Bonstetten, that the insalubrity of the air has rather increased than diminished since this partial draining was completed.

The south-east and south-west winds, the *scirocco* and *libeccio*, are extremely oppressive and insalubrious, though in winter the former contributes much to the mildness of the climate. The *tramontano*, or north wind, is delightful in spring and autumn, but in winter it occasions severe cold. The *ponente*, or west wind, still retains the character of the zephyrs, and the Favonian breezes of the ancients.

The wind commonly blows from the east in the morning; declining sometimes to the north, it becomes north-east, and at other times, turning to the south it settles in scirocco. It is generally south, however, at noon, and then declines to the east or west, but most frequently to the latter, and often becomes due west, which continues all the evening and part of the night. This and the northerly winds are generally accompanied with a considerable dew. The south wind, which prevails at noon, particularly in summer, is a sea breeze, and renders temperate the meridian heat of the sun. It appears from a meteorological table kept at Rome in March, April, and May 1803, that the average height of the thermometer exposed to the north in March was 60° Fahrenheit, in April 70°, and in May 68°. The *minimum* height during these three months was 52°, and the *maximum* 75°.

We have no information respecting the trade and manufactures of the Campagna, which must be very limited. Sulphur is obtained in great quantities from a mine about four miles from Nettuno; and at a place called Campo Leone, there are iron works belonging to Prince Doria. There are several paper, iron, and corn mills erected on the stream Marrana, near Grotta Ferrata; and there are various manufactures of paper, iron, and oil upon the Anio. Gunpowder is made on the spot where the villa of Mæcenas once stood. Flax is cultivated in considerable quantities in the Valle di Laricia; and a good deal of manna and turpentine is collected in the neighbourhood of Monte Spaccato. The cultivation of the vine is well understood in the Campagna, but no where are the inhabitants so little acquainted with the art of making wine. Oil is made in great quantities, and the proprietors derive a considerable part of their income from this source. The principal towns in the Campagna are Rome, Velletri, Frascati, Palestrina, Terracinas, Nettuno, Ostia, and Tivoli. See *Pliny*, lib. xviii. cap. i.; *Varro*, lib. ii.; *Neuste Statistische und Moralische Uebersicht des Kirchenstaats*, Lubeck, 1793; Keysler's *Travels*, vol. ii. p. 432—446; *Mem. Acad Par.* 1779, p. 579; Lumsden's *Remarks on the Antiquities of Rome*, London. 1797; *Voyage sur la scene des six derniers livres de L'Eneide*, par C. V. de Bonstetten, Geneve, 1805; *A description of Latium or La Campagna di Roma*, London, 1805; and Breislac *Voyage Physique et Lithologique dans la Campagna*, &c. traduit du Manuscript Italien, par le General Pommereuil, 2 vols, Paris, 1803. (*o*)

CAMPANACEÆ. See Botany, p. 74, § 29.

CAMPANULA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 141.

CAMPANULACEÆ. See Botany, p. 74.

CAMPBELL, Archibald, Marquis of Argyle, son of that Marquis of the same name who suffered death unjustly in the reign of Charles II. The father was firmly attached to the Presbyterian church of Scotland, and to the constitution of his country, as settled by law. He never disguised and never changed his sentiments with regard to either. But he lived in critical times; he was under the reign of a weak monarch; and he had many enemies among those, who, while they unfortunately enjoyed the royal confidence, were profligate enough to abuse it to the purposes of bigotry, selfishness, and resentment. He was tried before the Scottish parliament for abetting the usurpation of Cromwell; though, in point of fact, he had done nothing more than submitted to it from necessity; and if it was criminal and treasonable to do so, his prosecutors and his judges were as guilty as himself. His destruction, however, was resolved upon; and, in spite of the ability of his counsel, the demonstrations which were given of his innocence, and the precautionary conduct of the king, who rather interfered in his behalf, he was condemned to be beheaded at the cross of Edinburgh. He bore his fate with heroic intrepidity and Christian resignation. It has been the general, and should be the universal, opinion that he suffered most unjustly. Clarendon's account of his conduct, trial, and execution, is given with great spirit, but with every degree of unfairness; nor is Mr Hume's representation of him much more consistent with truth.

The subject of this article was educated in the principles of loyalty and religion, and soon distinguished himself by his personal merits. When Lord Lorn, he was appointed colonel of the foot guards by a commission from the king, in which command he displayed great bravery at the battle of Dunbar. He persevered in his attachment to the royal cause long after its affairs were desperate, not merely continuing faithful as a soldier to his military trust, but even joining with the enemies of his family in promoting the king's interests, and doing every thing that he could to alleviate the sufferings of his master. Nor did he refrain from his opposition and active hostility to the new government, till he received orders from Charles himself, in 1655, to capitulate. This conduct, of which the monarch seemed to entertain a very high opinion, and which he rewarded at the time with marks of his confidence and favour, gave great offence to Cromwell, who pursued him with the keenest resentment, and excepted him out of the general pardon which he issued in 1654. After his capitulation, he lived as a peaceable subject; but his submission was evidently constrained, and accordingly he was the object of perpetual suspicion. He refused to own the authority both of the Protector and of Richard. Informations were repeatedly lodged against him; formal security was taken for his good behaviour; persons in his service were bribed to watch him; he was even committed to prison in 1657, when some disturbance took place in Scotland; and what shews as much as any thing the tone of his political principles, the king reposed in him as much confidence as he placed in any other person in the kingdom.

When Charles was restored, Lord Lorn went up to London to congratulate his majesty upon that event, and carried with him a letter from his father, which the king received in a kind and flattering manner. He remained at court during his father's trial, and employed all his influence to prevent the unjust and melancholy fate in which it issued. This labour of filial love, which was as amiable as it was unsuccessful, instead of winning the esteem, only embittered the animosity of his enemies, who immediately sought his destruction on the most frivolous pretext. Having convinced the Earl of Clarendon that his father had been treated most unfairly and injuriously, he wrote a letter to Lord Duffus, communicating that important fact, and using some free expressions respecting the conduct of those who had been most active in carrying on the prosecution. The letter was intercepted, carried to Lord Middleton, exhibited to the Scottish parliament, considered by them as a libel on their proceedings, and made the ground of a representation to the king, who, though he confessed there was nothing criminal in it, yet pronounced it indiscreet, and commanded Lord Lorn to go down to Edinburgh. His Lordship had no sooner arrived than he appeared before parliament, and made a speech in his own vindication. He was, however, committed prisoner to the castle. A process was commenced against him, and being found guilty of *leasing making*, or of creating dissension between the king and his subjects, by giving the former false information, he was condemned to lose his head, and to forfeit all his estates. The day of his execution, however, was left to the king's pleasure. When the news of this proceeding reached England, it filled the court with astonishment. Charles himself had no conception that any body of men could turn such a slight misdemeanour into a capital offence. And Clarendon declared, that if his majesty suffered such a dangerous precedent to take place, he would leave the kingdom as fast as his gout would permit him. After ten months imprisonment, Lord Lorn was liberated, June 4, 1663. By this time, Middleton, his inveterate foe, had fallen into disgrace, and his own friends risen to power. A royal patent restored to him his grandfather's title and estate, and, besides other advantages of a similar kind, the king, as a mark of his special favour, ordered him to be sworn a privy-counsellor.

The Earl of Lauderdale, to whom he was partly indebted for this change in his fortunes, received from him considerable support in the administration of public affairs. Argyle, however, would never countenance or assist him in any of his violent measures. They were both Presbyterians; but Lauderdale carried the prerogative high, and vigorously maintained the bishops in Scotland, because he found all this conducive to the preservation of his influence at court; whereas, Argyle acted in strict conformity to his principles, and was a Presbyterian both in heart and in practice. Through the tyrannical procedure of Lauderdale, Archbishop Sharp, and others, a spirit of rebellion was engendered among the people, and in 1666 it burst forth in the west with considerable fury. The Earl of Argyle retained the loyalty by which he had been uniformly distinguished, and raised 1500 men to be employed in quelling the insurrection, though the Archbishop was too jealous to call them into the field. The rebels were defeated at Pentland. Great cruelties were perpetrated by the king's troops after the battle, and cruelties still greater and more extensive were committed by his ministers and judges under the form of trial, and under the pretexts of justice. His majesty himself interposed to prevent the farther effusion of blood: but it was not long before his servants had recourse to the same excessive severities which had formerly provoked the country to take up arms. Lauderdale, who was now created a duke, began to forsake some of his old friends, who refused to lend their sanction to his arbitrary conduct. Among these was the Earl of Argyle. But the minister knew too well his influence with the king, and his interest in the country, to deprive him either of his seat at the privy-council board, or of his place as a lord of the treasury. Lauderdale, in 1678, most inhumanly brought down the Highlanders, at that time a lawless and savage band, to live at free quarters in the western parts of the kingdom. To this measure, at once impolitic and barbarous, Argyle refused to give any active concurrence; but, at the same time, he acted a moderate and prudent part, by not joining in the attack which was made upon ministry in consequence of that unjustifiable step. The Duke of York being sent by the king in 1681, to take the management of Scottish affairs, he conducted himself with so much temper in general, and so obligingly to the earl in particular, that they were on good terms for a considerable time. But the duke having questioned Argyle pretty closely about the government in Scotland, he discovered that he had principles and views quite adverse to those by which he himself and his brother were actuated; and, therefore, though still externally civil to him, he began to assume a coldness and reserve which indicated a change in his sentiments, if, indeed, his real sentiments towards the earl were susceptible of any change. An act was passed this year by the parliament for establishing a test, obliging all who filled any office, to swear that he would attempt no alteration in the constitution of church or state. While this act was under discussion, Argyle opposed it with the utmost boldness and vigour. And after his opposition had proved fruitless, he would not take the test without an explanation of the meaning which he attached to it. This was also done by the Marquis of Queensberry; while many expressed their scruples about the oath, and others refused to take it all. The earl sent his explanation to the Duke of York; his royal highness declared himself satisfied with it; and the earl was permitted to sign it in the qualified sense which he had affixed to it, and to sit and deliberate accordingly as a privy counsellor. It is also worthy of remark, that the privy council themselves, on the very same day, gave an explanation of the test similar to that which had been given by Argyle, and that the clergy were allowed the privilege of signing it, with an adjection to that purpose. But his lordship was an obnoxious man to those in power, and what was reckoned venial or innocent in others, was in him an unpardonable crime. A design was formed against him, and through the malice of his enemies, and his own consistency and firmness, on which they could always calculate, it unfortunately succeeded. He was most unreasonably required to take the test a second time as a commissioner of the treasury. He offered the same explanation: but when desired to subscribe it, which demonstrated to him that there was some insidious view in the proposal, he refused to comply with it. A complaint was sent to the king against him, and in the mean time he was committed prisoner to the Castle. But before an answer from his majesty could arrive, a prosecution was commenced. He was first accused of slander, leasing-making, and depravation of the laws; but after the king's letter came to hand, authorizing the procedure which was intended, the charge was altered, and he was indicted before the Court of Justiciary for high treason and perjury. The conduct of the prosecutors in every part of it, showed that there was a determination to cut him off. The plainest maxims of justice were violated without remorse; and a degree of zeal was exhibited to procure his condemnation, which was altogether indecent even in those times of violence and oppression. The earl requested that Sir George Lockhart, his ordinary advocate, might be allowed and authorised to appear in his behalf. This most reasonable petition was refused once and again. About eight gentlemen at the bar, eminent for their talents and character, gave a written opinion, in which they declared that the earl's explanation of the test contained nothing illegal or criminal; and this was taken so heinously amiss, that it was made a matter of formal consultation whether those lawyers should not be prosecuted for scandal against the government. Argyle delivered a speech in his own defence, and offered two letters, one of them from the king, and the other from Middleton, in proof of his loyalty and faithful services, requesting them to be read and recorded in process; but the court would not allow them to be recorded after they were read, plainly because they went far to invalidate the interpretation put upon his conduct with regard to the test. After pleadings were heard at great length, the judges deliberated on the relevancy of the indictment, and it so happened that they were equally divided on that point, while the presiding judge declined giving his casting vote: but they were relieved from this dilemma, by bringing Lord Nairn, an old infirm man, out of his bed at midnight, from whom, though he had not heard the debate, and even fell asleep while the clerk was reading over to him the reasonings on both sides, they procured a vote against the earl. The cause was then remitted to an assize, consisting of persons known to be hostile to him, and whose sense of justice, if they had any, was still farther biassed by the king's advocate, who threatened them with a process of error. Neither the earl nor his counsel would say a single word more, as, from the interlocutor on the relevancy, and the whole complexion of the business, they perceived that speaking could be of no service, and refrained even from objecting either to the jury or the witnesses, though they could have urged valid objections to both. A verdict was very soon brought in, all in one voice, "finding the Earl of Argyle guilty of treason, leasing-making, and leasing-telling; and, by a plurality of votes, finding him not guilty of perjury,"—thus endeavouring to impose upon the world by an appearance of candour and discrimination. The council immediately sent a letter to the king, informing him of what had taken place, and asking leave to pronounce sentence. The earl concluded, from a variety of circumstances, that the utmost rigour was to be expected from the government in Scotland, and knowing also that a thoughtless, dissipated, unprincipled king, however much he might otherwise be disposed to favour him, would be easily influenced by these advisers to give any order on which they were pleased to insist, he used means of making his escape from the castle, and succeeded in the attempt. In a few days he got safe to London, leaving his enemies in Scotland to express their resentment as they best could; and they did it, after receiving the king's permission, by proclaiming his sentence at the Cross, and tearing his coat of arms in pieces, as if he had been in open rebellion, and had fled from justice. It was well known at court that he was residing in London, for he did not take any extraordinary pains to conceal himself; but no notice was taken of him, although he was represented there as a person of dangerous principles, who had been guilty of treason, and who had even sinned grievously after his conviction, by making his escape, and thus distrusting the royal clemency. It is even said, that when some person very eagerly and officiously put a note into the king's hand, intimating, that the earl might be easily apprehended, his majesty, with an indignation at the idea which did him honour, tore it, and replied, "*Poh, poh, hunt a hunted partridge! for shame!*" This is given by the editor of the *Biographia Britannica*, on the authority of private information; and it is well, if it be true. But it would appear that the earl did not trust much in the king's generosity, for he took the first opportunity of going over to Holland, where he continued during the remainder of Charles's reign.

On James's accession to the throne, many gentlemen belonging to Scotland, who had been driven from their native country by the illegal and oppressive measures of the government, began to think of some hostile attempt against the arbitrary power to which their expatriation was owing; and, aware of the respectability and influence of Argyle, they proposed that he should place himself at their head, and endeavour to accomplish by force what he could not hope to obtain by gentler means. To this proposal he readily acceded. It was not against his country, but in its behalf, that he was about to take up arms. It was to maintain the cause of civil and religious liberty—of justice and humanity—of patriotism and of truth; it was to restore a constitution which had been destroyed by its lawless and savage administrators; it was to give back to the people of Scotland those rights of which they should never have been deprived; and to re-establish the connection which he and his followers naturally had with that kingdom, and which had been dissolved by the hand of unprincipled violence. These were the views which actuated the breast and sanctified the conduct of Argyle, in that *rebellion*, as it has been called, by a very ordinary misnomer, which he directed against the government of King James. But it did not please Providence at that time to crown the efforts of patriotism with success. The skill of Argyle's management, indeed, was not equal to the excellence of his object and the purity of his intention. Many untoward and unforeseen circumstances occurred to thwart his plans. Of the people from whom he looked for active and zealous assistance, but who were now greatly dispirited by the harsh treatment they had experienced, much fewer joined him than he had reason to expect. His measures were even disconcerted by the refractory temper of those who, though under his command, were yet too essential to his success to have their opinions slighted. The Duke of Monmouth, too, who engaged to make a similar attempt in England, conducted himself weakly and imprudently, and this tended to throw discredit on the corresponding movements in Scotland, and to render the accomplishment of their united purpose impracticable. The whole enterprise failed almost as soon as it commenced. Argyle was taken prisoner in the neighbourhood of Paisley. He was immediately carried to Glasgow; and from that, in a few days, to Edinburgh. The manner in which he was compelled to enter that city was most ignominious. More disgraceful treatment could not have been given to the vilest criminal; but at that period it was the wise and the good who chiefly suffered, and great personal merit seemed to be almost uniformly the signal for persecution and death. The Earl's fate was speedily fixed. It was indeed a subject of deliberation, whether he should be punished according to his former sentence, or in consequence of a new trial and conviction. But it was decided without any hesitation, that he should be put to death; and, as if it had been to shew how utterly the rulers of the country at that time set all the maxims of law and justice at defiance, and how much they disregarded the opinions of the world and of posterity, they condemned him to die on the sentence pronounced against him in 1681, which nobody could justify or defend, instead of impeaching him for taking up arms against the government, which was at least a plausible ground of accusation. The Earl bore his fate with all the composure and magnanimity of a Christian. He was beheaded at the Cross, on the 30th of June 1685, and both in his whole behaviour, and in the speech which he delivered on the scaffold, gave a most unequivocal testimony to the truth and power of religion. Of his deportment on that interesting occasion, Wodrow has given a very particular and affecting account, which is highly worthy of the reader's perusal, and of which he may also see a beautiful abridgement in Fox's *History of the Reign of James II.* See Wodrow's *History of the Sufferings of the Church of Scotland*; Burnet's *History of his own Times*; *Scots Mist cleared up*; *Original MSS. in the possession of Mr Blackwood, Bookseller, Edinburgh.* (τ)

CAMPBELL, George, D. D. was born at Aberdeen, on the 25th of December 1719. His father, who was one of the ministers of that city, died suddenly in 1723, and left his family, consisting of three sons and three daughters, in circumstances not very affluent. This event, which at first bore an unfavourable aspect on the future fortunes of young George, proved advantageous to him, by the necessity of personal exertion which it imposed, and by the early and powerful stimulus which it gave to the innate energies of his mind. He studied the languages at the grammar school and university of his native place. In the former, the Latin tongue was taught with great ability, and in the latter, a taste and zeal for Grecian literature had been happily introduced by Professor Blackwell, whose eminence in that department is well known to every scholar. George Campbell made great proficiency in both, and thus laid the foundation of that critical erudition by which he was afterwards so much distinguished. At first he intended to follow the profession of a lawyer, and actually served an apprenticeship with a writer to the signet in Edinburgh. But, from what cause it is not known, he soon abandoned that view, and began to qualify himself for the clerical office. The short time, however, which he spent in studying law was attended with advantage, as it furnished him with a general knowledge of that important subject, accustomed him to closeness and ingenuity of reasoning, and gave him the faculty of drawing up papers with accuracy and skill. And though in making these acquisitions he had been tempted to neglect his Greek, yet he soon recovered what he had thus lost, when exertion and application became necessary. Having attended the theological classes, both at Edinburgh and Aberdeen, during the requisite number of years, and having undergone the probationary trials prescribed by the laws of the church in such cases, he was licensed to preach the gospel by the presbytery of Aberdeen, on the 11th of June 1746. In the following year he was a candidate for the parish of Fordoun, but for reasons which it is unnecessary to mention, he did not succeed in the application. Another year, however, did not elapse, till he received preferment. In 1748, he was ordained minister of Banchory Ternan, in the presbytery of Kincardine-o-niel, which living he obtained through the generous and disinterested patronage of Sir Alexander Burnett of Leys. In this parish he was chiefly distinguished by his powers of lecturing or expounding the scriptures, a practice which forms a regular part of the service observed in the church of Scotland, and has been found extremely useful in promoting the religious knowledge of the people. And it was while engaged in this important and laudable exercise among the humble rustics over whom he was set, that he first entertained the great design which he afterwards so ably and happily executed, of giving a new translation of the gospels. It is curious also to observe, that in this country parish, where scarcely any thing could occur to draw his attention to the niceties of grammar and the beauties of composition, and where all his ordinary duties and pursuits were rather hostile to metaphysical investigations, he composed a great part of his acute and excellent work on the Philosophy of Rhetoric. Here, too, he entered into a matrimonial union, by marrying Miss Grace Farquharson of Whitehouse, a lady of good understanding and amiable dispositions, who uniformly and minutely attended to his comfort, and who was happily spared to him till a very few years before his death.

In 1757, he was translated to Aberdeen, and became one of the city ministers. This new situation, in which he had easy access to books, enjoyed the opportunity of associating daily with literary men, and lived in the immediate neighbourhood of two universities, which held out to him objects of ambition and of hope, stimulated him to greater efforts, and led him on to higher attainments than he could have been expected to make in the narrow sphere to which he had been hitherto confined. Accordingly we find him more active in the pursuit of knowledge, and more successful, both in the acquisition and application of it. While he did not neglect the peculiar duties of his profession, and was especially so attentive to one branch of these, as to establish, and even increase his reputation as an expounder of holy writ, he allowed his studies to take a wider range, and began to cultivate, with equal diligence and success, the taste which he already indulged for literature and philosophy. About a year after his settlement in Aberdeen, a society was formed, which afforded him the means at once of improving his mind and displaying his talents. This society will be deemed worthy of record, when it is recollected that its leading members consisted of such men as Campbell, Reid, Gregory, Gerard, and Beattie, and that in it were first conceived, and partially produced, many of those writings by which these eminent men have done honour to themselves and service to mankind. Its constitution was well calculated to sharpen the intellect, to elucidate truth, and to ameliorate the social dispositions. Instead of that stiff formal procedure, common in such associations, which obliges the mind either to remain at rest, or to move in affected dignity, there was a spirit of freedom which expressed itself rather in easy conversation, than alternate debate, and combined pleasure with advantage. And in room of that party temper which sometimes takes possession of learned bodies, sacrificing truth and harmony and every thing else to its own contracted views, and converting a season professedly devoted to intellectual and social intercourse into an occasion of indulging illiberal feelings and angry passions, there was a predominance of good will and affection, which rendered the discussion of the gravest points agreeable, and invested philosophy with that moral charm and influence which should always grace her. At the meetings of this society a great variety of subjects were handled, into all of which Mr Campbell entered with his characteristic acuteness; and he himself delivered some very ingenious essays on rhetoric, criticism, and other topics to which his attention had been particularly directed.

He was made principal of the Marischal College in 1759. This preferment he owed to the patronage of the Duke of Argyle, (then the minister for Scotland,) to whom he applied for it by letter, and who, in consideration of his relation to that noble family, as well as of his acknowledged merits, procured the situation for him in preference to other two candidates of no inconsiderable pretensions. Hitherto he had published nothing but a sermon preached before the synod of Aberdeen in 1752, on the character of a minister, as a teacher and pattern: and he himself thought so little of it, as to exclude it from the collection of sermons which he made a short time before his death. In 1760, he was appointed to preach a second time before the synod of Aberdeen, and on that occasion he delivered a discourse on miracles. This he was requested to publish, and he agreed to do so after having moulded it into the form of a dissertation. As his object was to controvert the unsound and dangerous positions of Mr Hume, he bestowed the greatest care on this performance. He submitted the manuscript first to the Rev. Dr Blair in Edinburgh, and then to Mr Hume himself. By these gentlemen, one of whom was his friend and the other his opponent, he was favoured with various remarks, of which he very candidly took advantage, for the purpose of improving his work. Mr Hume complained that in some cases he had used harsh expressions, pointed out certain misapprehensions of his meaning, and stated objections to what Mr Campbell had advanced. Mr Campbell, with the modesty and ingenuousness which distinguished him, removed what had given offence, either by its real or apparent severity, and at the same time introduced such additional arguments and illustrations as were suggested by the observations of Mr Hume. Having thus corrected his treatise, he gave it to the public in 1763, previous to which time he had received, without any solicitation on his part, the degree of doctor in divinity from King's College in Old Aberdeen. The *Dissertation on Miracles* is a work of great ability. The author shews a perfect acquaintance with his subject, detects the sophistry of Mr Hume with much sagacity, exposes all the equivocations of his language, and, in the course of a few pages, overturns the whole fabric of infidelity which that plausible metaphysician had raised, by demonstrating the fallacy of that hypothesis on which it had been built. Indeed a more masterly or conclusive performance can scarcely be conceived; and, without undervaluing the works of Mr Adams and Bishop Douglas, both of which are excellent, it may be safely asserted, that a careful perusal of Dr Campbell's Dissertation alone, is sufficient to do away all the effect of Mr Hume's reasonings on the subject of miracles. Mr Hume himself was much pleased with it, as he declared, in a private letter which he addressed to the author; and though he did not confess that it was victorious, he yet praised it for the learning and ingenuity which it displayed, and for the civil and obliging manner in which the Doctor had conducted such an interesting dispute. At the same time it should not be overlooked, that he continued to publish his Essay on Miracles unaltered, and unexplained, and undefended, sheltering himself, no doubt, under the convenient resolution of never noticing any answers to his writings that might appear, but certainly acting, in this respect, without any of that candid and enlightened regard for truth by which, as a philosopher, he ought to have been actuated. The Dissertation was very favourably received by all who took an interest in those disquisitions which it embraced, and was particularly acceptable to the religious world, who saw in it a complete antidote to the poison circulated by Mr Hume, and in its author a champion for the truth, from whom still greater efforts might yet be expected. It was also soon translated into the French, Dutch, and German languages; and from this time Dr Campbell's name was honoured and respected among all the learned men in Europe.

The twelve years during which he held the offices of principal of Marischal College, and one of the ministers of Aberdeen, were employed by him in a diligent discharge of his professional duties, and in such other studies as his inclination led him to cultivate. He became a proficient in the science of Botany, which he afterwards found useful in the critical illustration of scripture. He improved his acquaintance with the Greek and Latin. He acquired a competent knowledge of the Hebrew. He made himself so far master of French and Italian as to become a critic in these languages. And he made considerable progress in the composition and revision of his work on the Philosophy of Rhetoric.

In 1771 the town council of Aberdeen appointed him professor of divinity in Marischal College, in consequence of which he resigned his situation as one of the ministers of the city, though he was still under the necessity of preaching once every Lord's day in one of the established churches. In his new capacity he made great exertions to be useful. He even did more, in the way of lecturing on theology, than the ordinary rules of his office prescribed; and introduced several improvements into the mode of teaching his class, which shewed the soundness of his own judgment, and the zeal with which he laboured for the advancement of his pupils. The same year in which he was raised to the divinity chair, he published a Sermon which he had preached before the synod of Aberdeen, entitled, *The Spirit of the Gospel, neither a Spirit of Superstition nor of Enthusiasm.* This sermon, which abounds in enlightened views and liberal sentiments, was violently attacked both by Nonjurors and Methodists; but the author did not observe any thing in these attacks sufficiently important or interesting to provoke a reply. He maintained a dignified, not a contemptuous, silence; and his discourse, from its obvious and intrinsic superiority, has survived all the clamours that were raised against it by weak or furious bigots.

In 1776, Dr Campbell published his *Philosophy of Rhetoric*, in 2 vols 8vo: a work on which he had bestowed the labour of many years, and which reflects the highest honour on his intellectual character. It affords a display of grammatical skill, critical acumen, discriminating taste, and philosophical talent, of which there are but few examples in the republic of letters. Throughout the whole work we discover traces of a superior mind. Those passages are particularly worthy of perusing, in which the author treats of abstraction, on which subject he differs from Dr Reid; of the cause of that pleasure which is derived from the representation of distressing scenes; of the nature and use of verbal criticism; and of the different sources of evidence, which is perhaps the most valuable portion of the performance, and is certainly equal to any thing which has yet appeared upon the subject. The style of this production, like the style of all his productions, is simple, perspicuous, and precise.

During the same year he preached on the national fast day, a *Sermon on the nature, extent, and importance of the duty of Allegiance.* In this sermon he endeavours to shew, that the Americans had no right, either from reason or from scripture, to throw off their allegiance to the British government. But though he reasons with his usual acuteness, it is not with his usual success. There are certain great principles which operate irresistibly on the feelings of a people suffering from oppression, and struggling for liberty, though they may not very readily occur to an orator in the pulpit of an established church; and it is by overlooking these, that the Doctor has so easily arrived at his conclusion. It may be remarked, that while he denies the *right* of the Americans to assert their independence, he very plainly hints the *expediency* of having granted it to them from the very beginning. Our government, labouring under a strange infatuation, were neither so just as to admit the claims of right, nor so wise as to yield to the dictates of expediency; and at length they were brought under the imperious *necessity* of surrendering what they had hitherto withheld; nor is there any reason to think that this event was delayed by Dr Campbell's sermon, although, at the desire of Dean Tucker, with whom the doctor carried on a correspondence, 6000 copies of it were published and industriously circulated in America, to persuade the people there to resume their political chains.

The next sermon which Dr Campbell preached and published, was of a different complexion, and calculated to be far more useful. It was delivered before the Society for Propagating Christian Knowledge: It is entitled, "*The Success of the First Publishers of the Gospel a Proof of its Truth*," and is certainly a very able performance—illustrating, with great distinctness and force, the argument that Christianity derives from the unfitness of those means by which it was originally propagated, taken in connection with the wonderful success which attended them.

Dr Campbell's hostility to Popery had been repeatedly evinced, and on account of it he had received injurious treatment from some Roman Catholics. His hostility, however, was not blind and indiscriminating. And while he abhorred the corruptions of doctrine which existed in the Church of Rome, he equally abhorred that arrogant temper and persecuting spirit by which she had been long distinguished; and abhorred them, too, for their own sake, not for the sake of that system of error and superstition to which they were more peculiarly attached. In 1779, therefore, when a bill was brought into Parliament for repealing the penal statutes against Roman Catholics, and when there was such a general and outrageous opposition to that measure maintained in this country, he published *An Address to the People of Scotland upon the Alarms that had been raised in regard to Popery*; and in this pamphlet, while he explains the nature of persecution, he demonstrates its contrariety to the gospel, and inculcates those tolerant and liberal principles which are dictated alike by true religion and sound policy. Such conduct, of course, exposed him to obloquy; but he had magnanimity enough to despise it, and to remain firm in his attachment to the great cause of toleration. It may be proper here to take notice of a very strange and stupid misrepresentation of Dr Campbell's sentiments with respect to the Roman Catholics, which appears in Mr Good's *Memoirs of the Life and Writings of Dr Geddes.* In that work, Dr. C. is ranked among the bigots of Scotland, who opposed the repeal of those penal laws to which the Catholics were subjected, and is even said to be the author of a tract in which that opposition is vindicated. The fact is, that Dr Campbell was an avowed and strenuous friend to the repeal; and the tract just mentioned bears on its title-page, that it was written in answer to his address to the people of Scotland in behalf of that measure! Such a gross blunder on the part of Mr Good is altogether unaccountable, except on the supposition that he wrote without any attention to the accuracy of his statements. In the same year, Dr Campbell published a sermon preached at the assizes at Aberdeen, on *The happy Influence of Religion on Civil Society.* This subject, which is rather a trite one, he has discussed with great precision, and with some originality. Indeed, the excellence of this, and others of his discourses which have been published, makes it a matter of regret that the world has not been favoured with a more copious collection.

The last work which he published was, *The Four Gospels, Translated from the Greek, with Preliminary Dissertations, and Notes Critical and Explanatory.* It appeared in 1789, in 2 vols. 4to. Of this production it is not easy to speak in too high terms. It must be considered, and is actually considered by all who are capable of forming a judgment, as a most important acquisition to the library of the biblical student. The *translation* is well executed; and though it unquestionably is in several respects inferior to the common version, yet the more it is read and studied, the more will it be admired. It is wonderfully free, as might have been expected in the productions of such an author, from the undue influence of system, and is frequently very happy in throwing light on what was formerly obscure, and in giving a meaning to what was formerly unintelligible, by the simple alteration of a word or a phrase. Dr Campbell, however, intended rather to call the attention of mankind to a new translation, than to exhibit his own as faultless. The *Notes* are extremely valuable—not so much for the extent of learning, as for the judicious application of that learning to the elucidation of scripture, which they uniformly display. Some of them are master-pieces of annotation. The *Preliminary Dissertations* contain some of the ablest critical discussions that are any where to be found. They are marked by a thorough acquaintance with the original scriptures; by an exercise of judgment at once discriminating and profound; by a perfect knowledge and a sound application of the canons of criticism; and by that perspicuity of statement, and that simplicity of style, which are necessary to give the other properties their full effect.

In 1791, Dr Campbell was seized with a violent illness, and his life was despaired of. On this occasion, he gave a testimony to Christianity, which it is proper to record: "God has been pleased," said he, "to give me some understanding of his promises in the Gospel of his Son Jesus Christ. These I have communicated to others in my life. I now entertain the faith and hope of them; and this may be considered as the testimony of a dying man." Contrary to all expectation, he was restored to the capacity of engaging in his former duties and studies. After labouring for four years longer, having lost his wife whom he tenderly loved, feeling himself inadequate, from age and infirmity, to the vigorous and multifarious exertions which his several offices required, and satisfied that he was to be succeeded by a person who was every way qualified to fill the situations from which he was to retire, he resigned them all in the year 1795, in favour of Dr W. Lawrence Brown, with whom he soon acquired habits of intimacy, and with whose appointment he frequently declared himself highly pleased. He received from government a pension of 300*l.* a year; a mark of public respect and gratitude which gave him unfeigned satisfaction, but which he did not live long to enjoy. On the 31st of March 1796, he was affected with a stroke of palsy, which deprived him of the power of speech, and seemed to deaden all his sensibilities. He languished under it for some time, and died without pain, leaving behind him a reputation for piety and worth, talents, learning, and usefulness, of which there are not many such examples in the history of the church. In private life, he was sincere, affectionate, and friendly. His manner, in company, was unassuming and mild: his conversation lively, agreeable, and instructive. By the few whom he honoured with peculiar confidence and intimacy, he was remarkably beloved. All who were acquainted with him, paid him the willing homage of esteem and veneration. In him the sterner and the gentler virtues were happily united: he awed by his unbending regard to integrity and truth, and he delighted by his affability and condescension. He belonged to what is called the moderate party in the church, but he was truly moderate. No entreaty on the part of his ecclesiastical friends could prevail upon him to become Moderator of the General Assembly; and no consideration could ever prevent him from speaking and acting in church courts, or in any other place agreeably to his own independent views. He had too much candour to be the leader, and too much elevation of mind to be the adherent, of a party.

Since his death, several works which he left in manuscript have been given to the public. These are his *Lectures on Ecclesiastical History*, which are thought by many to be latitudinarian in their views of church government, and have been the subject of much able and angry criticism:—his *Lectures on Systematic Theology and Pulpit Eloquence*, in which, with a great deal of sound and judicious remarks, there appears to be a portion of unreasonable prejudice against systems of divinity—and his *Lectures on the Pastoral Character*, which seems to be the most feeble and most faulty of the Doctor's productions, and might with great propriety have been suppressed by the editor. (*r*)

CAMPBELLTOWN, or as it is vulgarly written, *Campbelton*, a royal burgh of Argyleshire, is situated on the east coast of Kintyre, within twelve miles of the extremity of that long peninsula. Before it received its present name, about a century ago, in honour of the Argyle family, its proprietors and benefactors, it was called Kinloch (Loch-end), and Cean loch Chille Ciarain, in allusion to its position at the extremity of Kilkerran loch. This fine bay, which extends into the country above two miles, in the form of a crescent, is the harbour of Campbelltown. Being completely sheltered on every side by high grounds, it affords security in all weathers, the insulated rock at the entrance effectually breaking the swell. This natural harbour is two miles long and nearly one in breadth, having a depth of from 6 to 11 fathoms, and the best holding ground imaginable. The town itself, which is situated at the western angle of the bay, presents nothing particularly striking to the view; though, from the high grounds in the vicinity, there is one of the grandest prospects in the world. On the east you have the whole Firth of Clyde, covered with ships; at the distance of 12 miles the island of Arran stretches out before you; a little further to the south is the stupendous rock of Ailsa, rising out of the water in the form of a sugar-loaf; beyond, at a vast distance, are the blue mountains of Ayr and Galloway; and looking in the opposite direction you see the north of Ireland, some of the western isles, and the immeasurable expanse of the Atlantic.

Dr Smith, in his Statistical Account, asserts, that here was the first establishment of the Dalriads, those Irish adventurers who are said, in the sixth century, to have re-established the Scottish monarchy; and, as a proof of this, that one of the adjacent villages is still called Dalruadhain. This is not the place for discussing the doctor's theory, nor enquiring whether the Dalriads had any town at all. One thing, however, is certain, that there is not one vestige existing of a Scottish capital in this place; the most ancient building remembered being a castle of the Mac Donalds of the Isles, which occupied the spot on which one of the churches now stands. We know little more of the history of Campbelltown, than that in the 17th century, it was already a considerable fishing village; that in 1701, it was erected into a royal burgh; and that in 1755, according to the returns made to Dr Webster, the whole parish, town and country, contained a population of 4597 souls. In 1791, the inhabitants amounted to 8700; of whom the town contained nearly 5000. The population of the town has been rapidly increasing within these last ten years; its present numbers (1812) being above 6000.

The inhabitants of Campbelltown and the neighbouring district, consist of two distinct races; the Gael and the Goil, or Highlanders and Lowlanders. About 200 years ago, a colony of the latter was invited from the opposite coast to settle here by an earl of Argyle, who at the same time that he afforded a comfortable asylum to an oppressed people, obtained a tenantry for his arable lands, far superior to the indolent natives. No Jews ever preserved their original character more distinctly among a strange people than these Lowlanders have done. Though never amounting to a number equal to one third part of the natives, with whom they have been all along mixed, they have to this day preserved their own original names, language, manners, and dress, and retain even some degree of that religious enthusiasm and taste for the scholastic theology, for which Ayr and Galloway were so famous at the period of the migration. It is not 20 years since a prophet arose among them, who published visions and predictions exactly in the manner of Alexander Peden, the famous Gallovidian seer. This distinction of character is much less marked in the town than in the adjoining districts, as the English language is there universally understood, and the more frequent intercourse with strangers has diminished peculiarities. Even there, however, the Lowlanders have their own dissenting meeting-house and minister; and are remarkable for their sobriety, industry, and success. Notwithstanding the remote situation of this interesting little town, being nearly 200 miles by land from Edinburgh, the better classes are remarked for their politeness and intelligence; the females are not above three days in point of fashion behind the ladies of our metropolis; and strangers are not a little surprised to see the numerous and genteel assemblage of both sexes which can be mustered on occasions of festivity. The fact is, that from the establishment of excellent packets plying almost every day from this place to Greenock and Glasgow, the intercourse with the Lowlands is scarcely affected by the distance. The proportion of poor people is here very great, consisting of the widows and orphans of sailors, of whom several perish annually; of indigent families, who come in from the country for incidental employment; and of swarms of professed beggars, who lay the whole peninsula under contributions.

The antiquities of this place are not numerous, the only object of the kind within the town being a handsome cross, with a half obliterated inscription in Gothic characters, brought, it is said, from Iona. In taking a short walk to the westward of the town, you pass by the two batteries which defend the harbour, and arrive at Kilkerran, a most romantic sequestered spot. In the middle of the burying ground are seen the ruins of the chapel dedicated to St Kerran, who was one of the first Christian missionaries. A little further on are the remains of a castle built by James V. during his visit in these parts, to overawe the Macdonalds; but before his majesty had well left the harbour, the garrison, it is said, was taken, and the governor hanged over the walls Turning to the south you observe some great caves in the rocks which face the Frith. One of them contains, on all sides, a range of natural seats; another, which was the residence of St Kerran, is in the form of a cross, and has three fine Gothic porticoes. On the floor of this cave is the figure of a cross, together with a circular basin, cut out of the rock, and full of sweet water; from which the saint of old derived his salubrious beverage.

The town is governed by a provost, two bailies, a dean of guild, and a council; is the seat of the presbytery of Kintyre; and returns a member of parliament, in conjunction with Inveraray, Rothsay, Ayr, and Irvine. Having no landed property, its funds depend entirely on dues levied on commodities from the country, on harbour dues, the rents of a mill, and church seats; for the receipt and management of all which revenues, there is a public treasurer. The parish of Campbelltown, having originally consisted of four distinct parishes, is very extensive, and comprehends a population of above 9000 souls. For their accommodation, however, there is but one serviceable church, and the Lowland meeting-house. Another church was built some time ago, at a great expence, for the exclusive accommodation of the Gaelic hearers: but owing, it appears, to some absurd miscalculation, the roof has assumed a most threatening attitude. The parish living is divided between two clergymen, each of whom preaches alternately both in English and Gaelic. The public school has two masters, and is in a flourishing condition.

The principal necessaries of life are supplied in the greatest abundance from the vicinity; as potatoes, butter, cheese, beef, and mutton; of all which articles considerable quantities are exported to the neighbouring markets. The quantity of butcher-meat, annually slaughtered for the consumption of the town and shipping, now considerably exceeds 1000 bullocks, and as many sheep. The only necessary of life, of which there is any considerable importation, is oat-meal, which, to the annual amount of 3000 bolls, is brought from the Lowlands and Ireland; but, as the writer of the statistical account justly observes, the people have themselves to blame for this apparent deficiency, upwards of 7000 bolls of grain being every year converted into whisky. Peat continues still to be used as fuel by the poorer people, though a seam of excellent coal is worked within a few miles of the town, to which the coals are conveyed by a small canal.

The situation of this peninsular town is admirably well calculated for traffic. The neighbourhood abounding in corn and cattle, provisions are obtained at a reasonable rate; and the navigation to the fishing grounds, to Inverary, Greenock, Glasgow, Ayr, and the coast of Ireland, so extremely short, that a more central position for the coasting and home trade cannot any where be found. The herring fishing still continues to be the principal occupation of the inhabitants, of whom above 700 men have been known to be out in one season. During its most flourishing period, the following was an average statement of seven years: $50\frac{2}{7}$ vessels, $3004\frac{3}{7}$ tons, $674\frac{6}{7}$ men, 7412 barrels of herrings. Government fostered with unsparing liberality the infancy of this lucrative trade, from which Campbelltown alone has realised a very considerable capital, perhaps not less than 60,000*l.* sterling. The herring fishery, however, has of late been found rather unprofitable, and at present not above 2000 tons of Campbelltown shipping are employed in it. The people of capital are now beginning to embark in the foreign and coasting trade. Already more than 1000 tons of shipping are employed by them in these new channels; and last year (1811), the sum of 3000*l.* sterling was laid out here in the purchase of vessels, larger and better calculated for general business than the herring busses.

In this place there are but few manufactures. Besides the great distillation of whisky already mentioned, the weaving of cotton was introduced some years ago; but with what success we are not informed. Of late, a woollen manufacture has been set agoing by Mr Clarke, on a pretty large scale; in which the various processes of carding, spinning, weaving, &c. are carried on by the new machinery.—This extensive and laudable undertaking is patronized by the Duke of Argyle, and promises well, as a ready market is found for the cloth in the vicinity, and in Ireland. Campbelltown is situated at N. Lat. 55° 26′, W. Long. 5° 34′. (E)

CAMPDEN, or CHIPPING CAMPDEN, formerly *Campedene*, a town of England, in Gloucestershire, is situated near the extremity of the county, in a fruitful valley, among cultivated hills and hanging woods. The town consists chiefly of one street, about a mile long. The principal public buildings are, the court house, which is situated about the middle of the street, and seems to have been built about the beginning of the fifteenth century; the market house, which was erected by Sir Baptist Hickes, Viscount Campden, in 1624; and the church, dedicated to St James, which is supposed to have been built in the reign of Richard I., and which stands on a gentle eminence above the town. It is a large Gothic edifice, and contains some of the finest marble monuments in England. The nave of the church is sixty feet high, with an aisle on each side. The tower at the west end is 120 feet high, and is finished with battlements and 12 pinnacles. The remains of a magnificent mansion, erected by Sir Baptist Hickes, are still to be seen near the church. It was an immense building, adorned with frizes, entablatures, and a profusion of sculpture, and is said to have occupied, along with the offices, a space of eight acres, and to have cost 29,000*l.* In the neighbourhood of the town there is a silk mill and manufactory.

The Coteswold games were held on Dover hill, about half a mile from the town of Campden. Number of houses in 1801, 255. Population 1213; of whom 694 were returned as employed in trade and manufactures. See Rudder's *New History of Gloucestershire*, fol. Cirencester, 1779; and Rudge's *General View of the Agriculture of the County of Gloucester*, Lond. 1807. (*w*)

CAMPECHE, or CAMPEACHY, from *Cam*, which in the Maya language signifies *serpent*, and *peche*, the little insect (*acarus*), called by the Spaniards *garapata*, which penetrates the skin, and occasions a smart pain; a town of America, in New Spain, situated in the intendancy of Merida, on the western side of a bay of the same name, which forms part of the gulf of Mexico. It stands on the Rio de san Francisco, and has a harbour which is large and shallow. The houses are built of stone; it has a good dock, and a fort which commands both the town and harbour. The exportation of the wax of Yucatan is one of the most lucrative branches of trade, but, owing to the insecurity of the harbour, vessels are obliged to anchor a good way from the shore. Between Campeche and Merida are two very considerable Indian villages, called Xampolan and Equetchecan.

The Campeche wood, (*Hæmatoxylon Campechianum*,) grows in great abundance in the neighbouring county. An annual cutting (*Cortes de palo Campeche*, takes place on the banks of the river Champoton, the embouchure of which is south of the town of Campeche, and within four leagues of the small village of Lerma. "It is only with an extraordinary permission," says Humboldt, "from the intendant of Merida, who bears the title of governor captain general, that the merchant can, from time to time, cut down campeche wood to the east of the mountains near the bays of Ascension, Todos los Santos, and El Espirito Santo. In these creeks of the eastern coast, the English carry on an extensive and lucrative contraband trade. The campeche wood, after being cut down, must dry for a year, before it can be sent to Vera Cruz, the Havanah, or Cadiz. The quintal of this dried wood (*palo de tinta*,) is sold at Campeche for two piastres to two piastres and a half (from 8s. 9d. to 10s. 11d.) The hæmatoxylon, so abundant in Yucatan and the Honduras coast, is also to be found scattered throughout all the forests of equinoctial America, wherever the mean temperature of the air is not below 22 degrees of the centigrade thermometer, (71° of Fahrenheit). The coast of Florida, in the province of New Andalusia, may one day carry on a considerable trade in Campeche and Brazil wood, which it produces in great abundance." The habitual population of the town is 6000. West Long. 90° 30′, North Lat. 19° 30′. See Humboldt's *Political Essay on the Kingdom of New Spain*, vol. ii. p. 247, 248, 249; see also the article BUCCANEERS in this work, vol. v. p. 32, col. 2. (π)

CAMPER, PETER, an eminent anatomist and natural historian, was born at Leyden on the 11th of May 1722. His family had long held a high situation in the magistracy of that city; and his father, Florent Camper, who had for some years been a minister of the gospel at Batavia, and had returned to his native country in 1713, was distinguished by his philosophical and literary accomplishments, and associated with the most learned characters of Leyden. Boerhaave, Gravesande, Musschenbroek, and Moor, were his most intimate friends; and it was in the society of these celebrated men that young Camper spent much of his youth, and from their conversation imbibed that love of science and the fine arts for which he afterwards became so conspicuous. At an early age, Camper was instructed by the famous Moor in the art of designing and painting; a study which, though he had no intention of prosecuting but as an amusement, yet was of the utmost advantage to him in his anatomical researches, as it enabled him to make drawings of such figures and preparations as he wished to have engraved. The plates with which his works are illustrated, are consequently free from many inaccuracies which dependence upon the delineations of others often renders unavoidable. His knowledge of geometry, which he also acquired when young, under the tuition of the celebrated Labordes, proved another useful auxiliary in his future pursuits, and gave a correctness to his elucidations which they could not otherwise have possessed. These studies, however, he soon quitted for more important acquisitions; and, having entered the university of Leyden, he devoted himself in a particular manner to medicine, which soon became his favourite study. The different branches of that science were then taught by Gaubius, Van Rooyen, the Elder Albinus, and Trioen; the age and infirmities of Boerhaave having disabled him from attending his public duty in the university, and from becoming the preceptor of the son of his friend. Under these masters, Camper soon rose to distinction; and when he received his degree of doctor in philosophy and medicine in 1746, he published two dissertations,—the one, *De Visu*, the other, *De Oculi quibusdam partibus*, which have both been much praised by Baldinger.

Having finished his studies at Leyden, he was now desirous of visiting the different capitals and universities of Europe, and of improving the acquaintance which he had already formed with several of their most eminent literati. But the age and growing weakness of his parents demanding the presence and the tenderest attentions of an affectionate son, prevented for a time the fulfilment of his wishes. This obstacle, however, was in a few years removed by their death, which happened in 1748; and Camper soon after set out for London. Here he associated with the celebrated physicians Mead, Pringle, Pitcairn, &c. He renewed his medical studies under Hunter, Sharp, Smellie, and Winchester; and his taste for natural history was awakened by his visiting the cabinets of Hans Sloane and Collinson, and the collections of Hill and Catesby. Endowed with an inquisitive and comprehensive mind, his researches were not confined to any particular branch of science. He delighted in the wide range of general knowledge; and examined, with the eye of a philosopher, the different improvements in every department of the arts. He attended the most eminent artists and mechanicians, deriving from each such instructions as were connected with their particular professions; and the improvements in naval architecture engaged a considerable share of his attention. Here, also, his taste for painting was not forgotten; and he even acquired some practical knowledge in the art of engraving. Having spent nearly twelve months in London, zealously engaged in scientific and literary pursuits, he went to Paris in the summer of 1749, where he was introduced to Buffon and some other distinguished characters, and where he remained about two months, visiting the principal public establishments of that capital. He then repaired to Lyons, and from thence to Geneva. During his stay at this latter city, he was appointed professor of philosophy, anatomy, and surgery, at Franeker, which obliged him to hasten his return to Holland. On his journey home, however, he staid a few days at some of the principal cities of Switzerland and Germany. At Basle, he visited Bernouilli; and in the library of that city, examined the writings of Erasmus, and the paintings of Holbein.

A severe malady with which he was seized at Leyden, during the winter of 1759, prevented him from entering upon the duties of his new office until the following autumn, when he began his prelections with a discourse *De Mundo Optimo.*[*] Not content, however, with the knowledge of his profession which he had already acquired, or the connections which he had formed in foreign countries, he revisited London during the vacation of 1752, and a second time attended the lectures of some of its ablest physicians.

At Franeker, Camper continued to teach with increasing celebrity, and was always attended by a numerous audience, until 1755, when he was appointed professor of anatomy and surgery at the Athenæum of Amsterdam. Here he remained nearly six years; and it was during his residence in that city that he published the first volume of his *Demonstrationes Anatomico-Pathologicæ*. But the bustle of the capital, and the wish of Mrs Camper to return to Friesland, determined him to resign his situation in the Athenæum; and, in 1761, he retired to his country-house near Franeker, still retaining, however, the title of honorary professor in that academy. His whole time was now devoted to the sciences; and he published the second volume of his *Demonstrations* in 1762.

After remaining two years in his retirement, he was nominated to the professorship of medicine, surgery, anatomy, and botany, in the university of Groningen. The vicinity of this city to his present habitation—the natural activity of his mind—and his love of fame—determined him to accept the situation. During the ten years which he continued a member of this university, his reputation daily increased. Besides many valuable papers on medical subjects, which he presented to the different societies of Europe, he made several important discoveries in natural history; and during the last years of his residence in Groningen, he gave a course of lectures on medical jurisprudence, which many of his colleagues, the magistrates of the city, and the lawyers, honoured with their presence and approbation. He quitted Groningen with regret; and received, on his departure, the most unequivocal testimonies of affection and esteem from many of the principal inhabitants. He often declared, that the years which he spent in that city were the happiest of his life; and that probably he never would have quitted a society where he was treated with such kindness and respect, had not the desire of Mrs Camper, and his resolution to superintend the education of his children, obliged him to make the sacrifice.

Camper now fixed his residence at Franeker for the education of his children; and, being freed from the labours of public teaching, he devoted himself entirely to his favourite pursuits. His studies, however, were for a time interrupted by the death of Mrs Camper, to whom he was most tenderly attached, and whose estimable qualities, during an union of twenty years, had constituted the chief comfort of his life. *Une juste douleur*, says his son, *detouna pendant long-tems son esprit de toute application aux sciences.* To relieve his mind from the pressure of affliction, he made a tour through the county of Bentheim, the duchy of Cleves, and Brabant. The paintings of Rubens, Vandyke, and the other great masters of the Flemish school, which he found at Antwerp and Brussels, fixed his attention for a while in these cities, and afforded him some moments of relaxation; and, in the following summer, he went to Paris, where he was delighted with the society of Franklin, Marmontel, Diderot, &c. He afterwards visited some of the principal cities in Germany, and associated with the most celebrated authors of that country. At Potsdam he was presented to Frederic the Great, who received him with great affability and respect; and, on his return, he had the honour of spending two days with his brother, Prince Henry of Prussia, at Rhynsberg. The researches of Camper were now chiefly directed to natural history; and every year added to his fame as an author and a philosopher. His studies, however, important and multiplied as they were, did not prevent him from taking a part in the public affairs of his country. He was twice elected a representative in the assembly of the province of Friesland; and, in 1783, he was appionted counsellor of the city of Workum, which entitled him to a seat in the college of the admiralty of Friesland. In 1787, he was nominated one of the council of the state, which obliged him to remove his place of residence to the Hague, and where he continued till his death, which was occasioned by a violent pleurisy, on the 7th of April 1789. His body was deposited in the tomb of his ancestors, in the church of St. Peter, at Leyden.

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[*] It is the practice in Holland, and also throughout all Germany, for professors to pronounce an inaugural discourse upon their admission. Camper, besides the above, successively began his lectures in the different universities of which he was a member, with discourses upon the following subjects; viz. "De anatomes in omnibus scientiis usu;"—"De admirabili analogia inter stirpes et animalia;"—and "De Pulchro physico."

The writings of Camper contain many important discoveries both in medicine and in natural history; and though he has published no work of considerable magnitude, yet, in the various memoirs which he has presented to the different learned societies with which he was connected, he displays great strength of reasoning and aptness of illustration. As he derived his knowledge more from observation than from books, he was always furnished with a multiplicity of facts to bring in support of his positions; and the clearness of his expressions and illustrations arose from the abundance of his resources. Camper was personally acquainted with the most celebrated authors of the age, and had been instructed by their conversation as well as by their works. It was his constant practice, while travelling, to keep a journal, in which he recorded every thing which he either heard or saw that was worthy of being known;—the appearance and nature of the country, and the systems, projects, and errors, both of philosophers and artists. He took drawings of every rare object in anatomy or natural history which he met with; and some of his journals contain a variety of useful and curious observations on agriculture, manufactures, and the form and composition of mountains.

Camper wrote upon every subject of medicine or surgery which was under public discussion during his time; and carried off the prize on several questions proposed by some of the learned societies on the Continent. He was also a member of many of those societies; and their memoirs were enriched by his valuable communications. Besides his *Demonstrationes Anatomico-Pathologicæ*, of which two parts only appeared, the one containing the structure and diseases of the human arm, the other the structure and diseases of the human pelvis,—he published separate dissertations upon the following subjects: "On the cause of hernia in new-born children,"—"on the sense of hearing in fishes,"—"on the physical education of children,"—"upon inoculation for the small pox,"—"upon the origin and colour of the negroes,"—"on the signs of life and death in new born children,"—"on infanticide, with a project for the establishment of a foundling hospital,"—"on the causes of infanticide and suicide,"—"on the intromission of air into the lungs of new-born children,"—"on the operation of lithotomy at two different times, according to the celebrated Franco,"—"on ulcers in the urethra, &c."—"upon the orang-outang and other kinds of apes,"*—"upon cancers,"—"upon lameness in infants,"—"upon lithotomy,"—"upon the classification of fishes according to the system of Linnæus,"—and "upon the fracture of the patella and olecranon." He also presented the following memoirs to different societies; viz. "Upon the *callus* of fractured bones,"—"upon the advantages and best methods of inoculation for the small-pox,"—"upon the theory and treatment of chronical diseases of the lungs, &c."—"upon the construction of bandages for hernia, and the best method of tempering steel used for these instruments,"—"upon the structure of the great bones of birds, and the manner in which atmospherical air is introduced into them,"†—"upon the cure of ulcers,"—"upon the characteristic marks of countenance in persons of various countries and ages," which was afterwards published by his son in quarto, in 1791, and followed by the description of a method of delineating various sorts of heads with accuracy,—"upon the discovery of the glands in the interior of the sternum,"—"upon contagious diseases among cattle,"—"upon specific remedies,"—"upon the effects of air, sleep, &c. in the cure of surgical disorders,"—"upon the nature, treatment, &c. of dropsy,"—"upon physical beauty,"—"upon the question, Why is man exposed to more diseases than other animals?"—and "upon the fossil bones of unknown and rare animals.

After his death, his son, M. Adrian Giles Camper, published in 1792 a sequel to his "Treatise on the natural difference of Features," &c. entitled, "Lectures of the late Peter Camper on the manner of delineating the different emotions of mind in the Countenance; on the striking resemblance between Quadrupeds, Fowls, Fishes, and the Human Species; and on the constituent Beauty of Form." In the year 1803 a collection of his works appeared at Paris in 3 vols. 8vo. with a folio atlas of plates, under the title of "*Oeuvres de Pierre Camper qui ont pour objet l'Histoire Naturelle, Physiologie, et l'Anatomie Comparé*," to which is prefixed, "An Essay on his Life and Writings" by his son; and two eulogiums; viz. one by Vicq. d'Azyr, and the other by Condorcet.

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* Camper published an excellent paper on the "organs of speech (he ought to have said *voice*) in the ouran-outang," in the 69th vol. of the *Trans. Royal Soc.* London, for 1779, in which he proved, by the best of all possible arguments, viz. the anatomy of the parts, the impossibility of that animal, apes, or monkeys, so modulating their voice as to articulate words; and thus shewed the absurdity of J. J. Rousseau's opinion, that they had lost their speech from disease.

His work on "delineating the emotions of mind in the countenance, &c." has been translated by Dr Cogan, and ought to be consulted by every painter, sculptor, and engraver. [Mease.]

† The discovery of this curious structure was first made by Camper in 1771. It has, however, been claimed by M. Hunter of London; but with what justice, it is difficult to conceive, as that gentleman's paper upon this subject was not read to the Royal Society until Feb. 1774.

If the abilities of Camper as a philosopher entitle him to our respect and admiration, the better qualities of his heart call for our esteem. He was distinguished by his domestic and social virtues, and performed the duties of a son and of a father with the most affectionate solicitude. He often sacrificed his own inclinations to the wishes of his aged parents, and sweetened their declining years by his presence and tender attention. Though his literary labours occupied much of his time, yet the education of his children was always his favourite employment, and we cannot better conclude this sketch of his life than with the affectionate testimony of his son: "Les tendres soins de mes parens pour mon bonheur, leur douce et franche intimité, mille et mille bienfaits dont ils m'ont comblé depuis le jour de ma naissance jusqu'a l'instant ou un meilleur monde est devenu leur partage, rappeleront sans cesse a ma memoire ces paroles admirables de la doctrine des Chinois: *Qu'on ne sauroit survivre a un pere, a une mere, que pour les pleurer chaque moment de la vie.*" (*p*)

CAMPHOR is a substance contained in many vegetables, and is of extensive use in the materia medica. The camphor of commerce is obtained from the laurus camphora, a forest tree which abounds in Borneo and Sumatra. It is found in perpendicular veins, near the centre of the largest and oldest trees, from which it is picked out by means of knives. It is generally procured, however, by sublimation. Small pieces of the stem and branches of the tree are put into an alembic, to the head of which is adapted a capital, containing straw. When exposed with a little water to a moderate heat, the camphor is volatilized, and attaches itself to the straw.

Camphor is also obtained by sublimation from another species of laurus, which grows in Japan; but this kind is not so much esteemed in the East as that which is obtained from Sumatra and Borneo. Camphor is likewise procured from the *Laurus Cinnamomum*, the *Laurus Sassafras*, the *Laurus Cassia*, the *Maranta Galanga*, the *Kæmpfæria rotunda*, and the *Asarum Europeum*; ginger, the seeds of cardamom, and long pepper; and from the essential oils of juniper, sage, hyssop, thyme, peppermint, rosemary, and lavender. See *Asiatic Researches*, vol. iv. p. 19; *Phil. Trans.* 1805; Nicholson's *Journal*, vol. x. p. 132; *Collect. Academ.* Part. Etr. tom. xiii. p. 43; *Disc. Prelim. et Part. Franc.* tom. ii. p. 206—223; and the *Journal de la Blancherie*, 1785, p. 393. See Chemistry and Materia Medica. (*o*)

CAMPHOROSMA, a genus of plants of the class Tetrandria, and order Monogynia. See Botany, p. 120.

CAMPYNEMA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 190; and Brown's *Prodromus Plant. Nov. Holl.* p. 290.

CAMUS, Charles Etienne Lewis, a celebrated French mathematician, was born at Cressy in Brie, on the 25th of August, 1699, and was the son of Etienne Camus, a surgeon of that place. At a very early age he displayed a great attachment to mechanical pursuits, and while his companions were amusing themselves at play, he was often found constructing some machine, with no other instrument but a knife. Before the eleventh year of his age, he felt such a passion for mathematical learning, that he entreated his parents to send him to the college at Paris; but from the narrowness of their circumstances, they at first hesitated about the prudence of such a step; and it was only from a well founded confidence in the wisdom and talents of their son, that they at last resolved to send him to the college of Navarre.

In a short time Camus became one of the best scholars at the college; and at the end of two years he was able to give lessons in mathematics, and thus to defray all the expences of his education.

Under the care of the celebrated Varignon, Camus applied himself to the study of the higher branches of mathematics, and he at the same time directed his attention to the subjects of civil and military architecture, mechanics, and astronomy. His knowledge of these subjects gained him the acquaintance and friendship of M. De Cotte, Couplet, and Cassini, and paved the way for his introduction into the academy of sciences. In the year 1727, that learned body having proposed as the prize subject, "The best method of masting vessels," Camus entered the lists, and had the good fortune to be among the number of those whose memoirs on this subject were published by the academy in the *Recueil des Prix*.

In consequence of this proof of his talents, Camus obtained, on the 13th August 1727, the place of adjunct mechanician, vacant by the promotion of M. Pitot. In the year 1728, he wrote a memoir on accelerated motion by living forces, a subject which was then agitated with much heat. On the 16th December, 1730, the academy of architecture appointed him professor of that science; and in 1733, he was honoured with the office of secretary to the same academy. He obtained the degree of associate to the academy of sciences on the 18th of April 1733. On this occasion the celebrated Clairaut was his competitor, and appeared upon counting the votes to have a majority of one in his favour. It was imagined, however, that some mistake had been committed in taking down the votes, and in consequence of this suspicion, the king, at the request of the academy, nominated both the candidates.

In the year 1736, Camus was sent along with Clairaut, Maupertius, and Monnier, to measure a degree of the meridian at the north polar circle. During this operation, which was completed in 1737, Camus rendered himself highly useful, not merely as an astronomer, but as a mechanician and an artist; and to his address and genius the operation owed a great part of its success.

When M. Mairan succeeded Fontenelle as secretary to the academy, Camus was appointed, on the 18th January 1741, to the situation of pensioner-geometrician held by that learned philosopher. In the same year, his attention was directed to the subject of measuring the capacity of vessels for containing liquids; and he invented a gauging-rod and sliding-rule for calculating the contents of casks of every form. In 1746, Camus found a difference between the length of the standard ell, and that which was fixed by law; and the academy being consulted on this subject, he was appointed, along with M. Hellot, to examine it. The cause of the difference was soon discovered, and likewise the reason why the ell was not composed of any aliquot parts of the toise. In 1747, Camus published a memoir on the tangents of points common to several branches of the same curve; and, a short time afterwards, he was appointed to the place of examiner of the schools of engineers and artillery. In this new situation, his time was much occupied by travelling, but he still found leisure to compose a complete course of mathematics for the use of the engineers, which appeared at different times, in 4 volumes 8vo.

In 1756, Camus was one of the eight academicians who were appointed to examine, by a new measurement, the distance between the centres of the pyramids of Villejuifve and Juvisi, which had formerly been measured by Picard; and he has given a full account of this operation in the Memoirs of the Academy for 1754.

Camus married, in 1733, Mademoiselle Fournier, by whom he had four daughters, only one of whom arrived at maturity. This lady, whom her father loved with the most unusual tenderness, was married to M. Pagin, treasurer to the Count de Clermont. In the rigorous winter of 1766, Camus caught a severe cold in his breast during his travels to examine the schools of artillery; and his health had just been re-established by M. Petit, when the death of his only daughter, on the 4th December 1767, occasioned a relapse. After this distressing event, his health gradually declined, and he expired on the 4th of May 1768, in the 69th year of his age.

M. Camus was above the middle size, and was distinguished by the frankness of his manner, and by an unyielding integrity of character. He left behind him a great number of manuscripts, among which were, treatises on the various subjects of Dialling, Mechanics, the Differential and Integral Calculus, Algebra, Hydraulics, Conic Sections; Perspective; on the Division of Time, and the Machines which are employed to measure it; on the Toise; on Vaults; on Winches; on Practical Geometry; on the application of Algebra to Geometry; on the Mines of Sweden.

The following is a complete list of the writings of Camus:

1. Cours de mathématiques á l'usage des Ingénieurs. Paris, 4 vol. *in* 8vo.
2. Elémens de mécanique.
3. Elémens d' arithmétique.
4. Du mouvement accéléré par des resorts et des forces qui resident dans les corps en mouvement. See *Mem. Acad.* 1728, p. 159. Hist. 73.
5. Solution d'un próblême de géométrie de M. Cramer. *Id.* 1732, p. 446.
6. Observations sur la figure des dents des roues, et des ailes des pignons pour rendre les horloges plus parfaites. *Id.* 1733, p. 117. Camus afterwards discussed this important subject at greater length in the 10th and 11th books of his *Cours des Mathematique.*
7. Obs. sur l'action d'une balle de mousquet, qui perce une pière de bois d'une épaisseur considèrable, sans lui communiquer de vîtesse sensible. *Id.* 1738, p. 147, H. 98.
8. Obs. sur la meilleure maniere d'employer les seaux pour élever de l'eau. *Id.* 1739, p. 157, H. 49.
9. Obs. sur les meilleures proportions des pompes, et des parties qui les composent. *Id.* 1739, p. 297, H. 49.
10. Problême de statique. *Id.* 1740, p. 201, H. 103.
11. Obs. sur un instrument propre à jauger les tonneaux, et les autre vaisseaux qui servent a contenir les liqueurs. *Id.* 1741, p. 385, H. 105.
12. Obs. sur l'étalon de l'aune du bureau des Marchands Merciers de la Ville de Paris. *Id.* 1746, p. 607, H. 109.
13. Obs. sur les tangentes des points communs a plusieurs branches d'une même courbe. *Id.* 1747, p. 272.
14. Obs. sur les opérations faites par ordre de l'Academie pour mesurer l'intervalle entre les centres des pyramides de Villejuifve et de Juvisi, en conclure la distance de la tour de Montlhéry au clocher de Brie-Comte-Robert et distinguer entre les differentes déterminations qui nous avons du degré du méridiens aux environs de Paris, celle qui doit être préférée. *Id.* 1754, p. 172, H. 103.
15. De la mâture des vesseaux. See *Recueil des Prix.* tom. ii. M. ii.
16. Maniere de fair agir de rames. Tom. ii. p. 45, 47, and 49.
17. Machine pour fair jouer à la fois plusieurs tamis. See *Machines Approuvées.* Tom. ii. p. 183, and 185. *(o)*

CANADA.

CANADA, sometimes called New France, or the *Province of Quebec*, is an extensive tract of country in North America; and is the principal British possession in that quarter of the globe. The relative position of this colony to the United States, and its immense extent of territory; its growing commercial importance, and its ability to supply our West India islands, in the event of interruptions to their intercourse with the Americans; the circumstance of its being hitherto little known to the inhabitants of Great Britain, and of much useful information having been recently acquired respecting it; all these considerations justly entitle it to a much larger space than it has hitherto occupied in works of this nature. The name Canada, in its most extended sense, and especially according to the usage of the French geographers, has been applied to the whole of that immense district, which is comprehended between the 43d and 50th degrees of north latitude, which reaches from the Atlantic to the Pacific ocean, in an inclined direction from north-east to south-west; but, in its more confined acceptation as a British colony, it is computed to extend about 1300 geographical miles, between the 64th and 97th degrees of west longitude; while its breadth, at a medium, is rated at 200 miles, though its greatest width, from Lake Erie on the south, or lat 43, to lat. 49, is about 360 miles. It is bounded on the east by the Gulf of St Lawrence; on the north, the west, and south-west, by the territories of different Indian nations; and on the south and south-east by New York, New England, New Brunswick, and Nova Scotia; but, except on the east, its precise limits are no where well defined. Even on the side of the United States, its boundaries are not yet definitively fixed; and have been the subject of much discussion, from the era of American independence to the present day. According to the treaty of peace between the colonies and the mother country, upon the termination of the American war, the line of division was to run from the north-west angle of Nova Scotia along those high lands which divide the rivers that empty themselves into the St Lawrence, from those that fall into the Atlantic Ocean, to the north-westernmost head of the Connecticut river; along the middle of that river to the 45th degree of north latitude; along the said latitude, due west, till it strikes the river Iroquois or Cataraguay; along the middle of that river, of Lake Ontario, of Lake Erie, of Lake Huron, of Lake Superior, of the Long Lake (which, however, has no existence), and of the Lake of the Woods; thence, on a due west course, to the river Mississippi; and along the middle of that river, till it intersect the northernmost part of the 31st degree of north latitude.

It is divided into two provinces, called Upper and Lower Canada. The former, which is the western division, is situated on the north side of the great lakes, or sea of Canada; and is inhabited chiefly by English settlers. The latter is situated on the river St Lawrence, towards the east, and is peopled by a greater proportion of French inhabitants. The lower province is divided into twenty-one counties: Gaspé, Cornwallis, Devon, Hertford, Dorchester, Buckinghamshire, Richlieu, Bedford, Surry, Kent, Huntingdom, York, Montreal, Effingham, Leinster, Warwick, Saint Maurice, Hampshire, Quebec county, Northumberland, and Orleans; 17 of which send two representatives each to the Provincial Assembly; and the other four, one each. It contains the following towns, besides a number of large and populous villages:—*Quebec*, the seat of government, situated on a lofty point of land, on the north-west side of the St Lawrence, nearly 400 miles from its mouth, very strong by nature, and completely fortified by art, contains about 15,000 inhabitants, and sends four representatives to the Assembly:—*Montreal*, 180 miles above Quebec, built on the east side of an island formed by the junction of the St Lawrence with the Utawas, the boundary between the two provinces, contains 6000 inhabitants, and also sends four representatives: *Trois Rivieres*, or *Three Rivers*, nearly midway between Quebec and Montreal, formerly a place of great resort to the Indians, contains about 250 houses:—The *Borough of William Henry*, (so named in compliment to his Royal Highness the Duke of Clarence,) situated in the Seigniory of Sorelle, on the south side of the St Lawrence, about 45 miles below Montreal, and which was originally laid out by the surveyor-general of the province, is principally inhabited by American loyalists and disbanded soldiers, who obtained small grants of land at the end of the American war, the Seigniory having about that time been purchased by the crown, in the view of forming a military position at this place; contains upwards of 100 houses, a Protestant and a Romish church, a government-house (the only brick building of any magnitude in the province), and a military hospital: the inhabitants are chiefly employed in ship building.

In the Upper province, the principal settlements (for they can scarcely yet be called towns), are—*Kingston*, 385 miles above Quebec, near the egress of the St Lawrence from Lake Ontario, which has increased and improved very rapidly since its foundation in 1784, and which contains several commodious dwellings built of excellent stone, a barrack, a jail, a court-house, a church, an hospital, several extensive store-houses, and a naval dock-yard:—*York*, or *Toronto*, the seat of government in Upper Canada, and about 450 miles above Quebec, which was laid out as the site of a town only in 1797, and has already made very considerable advancement:—*Niagara*, or *Newark*, at the west opening of Lake Ontario, and about 525 miles from Quebec, a very thriving and beautifully situated town:—*Queenstown*, about eight miles beyond Niagara, a neat, flourishing place, where all the merchandise and stores for the upper province are landed from the vessels in which they have been conveyed from Kingston, to be transported in waggons to *Chippawa*, or *Fort Welland*, about ten miles distant, which contains several store-houses, two or three taverns, and a wooden fort, with a garrison of 25 men.

The principal forts or military posts are, *Fort Carlton*, a little higher up the river, well garrisoned and fortified, and possessing an excellent harbour; *Fort Niagara*, situated at the ingress of the St Lawrence into Lake Ontario, and of great importance for the protection of the British Indians; *Fort Amhurstburgh*, between Lake Erie and Huron; and *Fort St Joseph*, upon an island at the western end of Lake Huron, and particularly essential to the commercial interests of Canada.

The import of the word Canada, and the reason of the country having been so named, are equally unknown; and, as a sufficient proof how little certainty there is on the subject, the following account of the matter, more ludicrous than satisfactory, may be submitted to the reader. A band of Spaniards having landed on the coast in quest of gold, which was then the sole object of pursuit with every voyager to America, and finding that the country yielded none of their favourite metal, frequently exclaimed to one another on their departure, in the presence of the natives, *Aca nada*, i. e. *here is nothing*. Upon the arrival of the French some time afterwards, the Indians, with a view to hasten their departure also, repeatedly pronounced the words which they had heard from their former visitors at their re-embarkation; upon which their new friends, imagining that it was the name of the country, immediately called it Canada.

This country appears to have been first discovered in 1495, by the famous Italian adventurer John Cabot, who sailed under a commission from Henry VII. of England, but who was not permitted by that cautious prince to attempt any regular settlement on the coast. In the beginning of the 16th century, it was visited by some French mariners, who were fishing on the banks of Newfoundland; and, in 1523, Francis I. sent four ships under the command of Verazani, a Florentine, to make discoveries in North America; but, after two unsuccessful attempts, having sailed on a third expedition, he was never heard of more. In 1534, Jaques Cartier, a native of St Malo, sailing under a commission from the French king, landed at several places on the coast of the Gulf of St Lawrence, and took possession of the country in the name of his sovereign.

In the year following, he made a second voyage, with a more formal commission, and with a much larger force; sailed up the St Lawrence, as far as the island of Orleans; experienced the most hospitable treatment from the natives; and, after wintering at St Croix, returned to France, with a flaming account of the fertility of the soil, and the value of the productions, but with no specimens of the precious metals. His failure in the discovery of these last mentioned commodities, brought him into some degree of disgrace; and in 1540, he was sent out only in the capacity of pilot to M. de Roberval, who was appointed viceroy of Canada; who made various attempts to discover a north-west passage to the East Indies; who frequently returned to France for new recruits; and who was lost, with a numerous train of adventurers, in 1749, without any tidings ever being received of his fate. By this calamitous event the government of France was so much discouraged, that, for nearly 50 years afterwards, no measures were employed to support the few French settlers, who still remained in North America. At length, Henry IV. appointed the Marquis de la Roche, lieutenant general of Canada; but that nobleman, sailing from France in 1598, having injudiciously attempted a settlement on the isle of Sable, and cruized for some time on the coast of Nova Scotia, without any success, returned home in disgrace, and died of grief. Other governors, however, were more successful in their expeditions; and by the increasing attractions of the fur trade, were enabled to collect great numbers of settlers, and to form a permanent establishment in Canada, or New France, as it was then designated. One of the most active of these adventurers was a naval officer called Champlain, a man of considerable enterprize and ability, who completely explored the banks of the St Lawrence, discovered the lake, which bears his name, and built the city of Quebec in the year 1608.[*] At this period two Indian nations, the Algonquins and Hurons, who occupied the district in which the new colony was planted, happened to be very hard pressed by their inveterate enemies the Iroquois; and, in the hope of procuring important assistance to their cause, readily welcomed and befriended the new settlers. Champlain, instead of endeavouring to unite the natives in general in an attachment to France, inconsiderately took a side in their contests; and thus raised up an enemy, of whose power and ferocity he was little aware, and whose rooted hostility presented perpetual obstructions to the future prosperity of the colony. The Iroquois never forgave this interference on the part of the French; and kept them in such a state of almost unceasing warfare, that, during a whole century at least, the European residents were never altogether free from alarms; were seldom permitted to reap and sow in safety; and were frequently in hazard of total extermination.

The infant colony was, for a long time, very much neglected by the mother country; and its support was chiefly entrusted to private individuals, who fitted out expeditions at their own expense and risk. As the persons, however, who conducted these enterprizes, were generally men of rank and fortune; and as they received from government the exclusive right to trade with the Indians in furs, they found no difficulty in procuring as many individuals to accompany them, as they were able to support; but still, their strength and numbers were never sufficient to ensure protection against the barbarous incursions of the savages.

The province of New France very soon became as much a missionary station, as a commercial settlement. A very general zeal for the Christian instruction of the Indians, was excited throughout the French empire; and many individuals of rank and property devoted their lives and their fortunes to the cause. The Jesuits, however, soon engrossed the sole direction of this undertaking; and were greatly instrumental in obstructing the prosperity of the colony, both by their perpetual contentions, which they maintained with the governors, and by the pernicious effects which their labours produced upon the character of the natives. The individuals, indeed, who were personally employed as missionaries, were generally men of true piety, always possessed of undaunted zeal, and frequently distinguished by extraordinary talents. Their astonishing hardships, unceasing perseverance, and heroic sufferings, can never be too highly applauded, and can scarcely be adequately described. Besides the ordinary perils and privations, to which they were daily exposed, they have often been known to rush into the midst of contending savage armies, for the purpose of discharging the duties of their office; calmly to employ themselves, amidst the horrid carnage of an Indian engagement, in baptizing the wounded and the dying; and generally in such cases to terminate their labours by the patient endurance of the most excruciating tortures. But all their exertions were unhappily attended with very little success; and in some respects even proved rather hurtful than beneficial. They habituated themselves to the modes of savage life; assumed the dress and occupations of the Indian tribes, whom they went to instruct; rendered themselves in a great measure dependent upon their protection and services; and in this manner too often incurred the contempt, instead of acquiring the veneration of the natives. Even when they were successful in their ministrations, they may be said to have made allies to the French, rather than converts to Christianity. They did little more, in most cases, than admit the Indians by baptism into the bosom of the Catholic church, instruct them in a few unmeaning ceremonies, and inspire them with a bigotted hatred of the unconverted tribes; while they left them as rude with regard to the arts of life, as ignorant of the principles of society, as averse to industrious habits, as regardless of Christian duties, as complete barbarians in short, in every respect, as ever they had been. Their converts even lost, in a great degree, the useful qualities of the savage, without acquiring the virtues of the Christian; relaxed their wonted courage and vigilance, and trusted to the Saints for defence against their enemies; depended upon their new allies, in many instances, both for protection and provisions; and thus became a heavy burden, instead of proving a useful barrier to the colony. The degraded appearance, also, and enfeebled spirit of the Indian band, who thus submitted to the tuition of the Catholic colonists in Canada, compared with the industrious pursuits, orderly conduct, improved habitations, and increasing comforts of those, who were instructed by the protestant missionaries, on the borders of New England, tended greatly to inspire the natives, in general, with a growing respect and attachment to the English, while it confirmed their contempt and dislike of the French. The English colonists naturally exerted their endeavours to encourage this predilection; and many of the Indians became still more partial to their intercourse, for this additional reason, that they found in these states a better price for their furs, than what the

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[*] It is said that some of his followers, upon their first view of the lofty point of land, on which the capital of Canada is situated, and which is 350 feet of perpendicular height, having exclaimed in astonishment, *Quel bec!* Champlain immediately resolved to bestow that name upon his projected town.

French merchants could afford. These two circumstances, the mutual hatred of the converted and unconverted natives of Canada, the former of whom were generally in alliance with the settlement at Quebec; and the principle which the French adopted, of treating all those Indian tribes as enemies, who carried their commodities to the traders of New England, or who received English missionaries among them, kept the province of Canada in a state of perpetual contest, as long as it remained in the possession of France. These ecclesiastical proceedings were so interwoven with the civil affairs of the colony, and had such an influence even upon its commercial interests, that this short sketch of their nature and effects, seemed necessary to explain and account for succeeding events; but it has led us rather to anticipate the general history of the province, and we now return to the narrative of a few of the most prominent particulars in its progress.

Until the year 1627, the prosperity of the settlement was greatly retarded by religious dissensions among the colonists themselves; but, at this period, the French minister, Richelieu, who cordially hated the Protestants, put the province of New France under the management of a chartered company. He endowed them with great privileges, upon condition, that they should exclude the Huguenots, and establish Catholic priests in every district; and gave them a constitution, which, with the exception of what regarded religion, has been reckoned as a model for colonial establishments. About this time Charles I. of England entered into a war with France; and Sir David Kirk, or rather Kertk, a French Calvinist, having received the command of three English ships, sailed upon an expedition against Quebec; defeated the squadron which was sent to its relief, and, after reducing the colonists to the greatest extremities, compelled them to capitulate in the year 1629. He fulfilled so faithfully the terms of surrender, and treated the vanquished with so much humanity, that the greater part of the settlers declined the privilege of being conveyed to old France, and remained under their conquerors in Canada. The colony was restored to France by the treaty of St Germain, in 1632; but it was only by the most astonishing exertions of a succession of able and enterprising governors, that its existence was preserved amidst the various difficulties under which it laboured, from the neglect which it experienced on the part of the mother country, from its own intestine divisions, and from the desolating excursions of the hostile Indians.

About the year 1662, it was reduced to the eve of destruction by the rash and haughty temper of the governor general, D'Avaugour. Previous to that period, he had issued the strictest orders against selling spirituous liquors to the savages; and a woman of Quebec, having been detected in that pernicious traffic, was instantly committed to prisen. By the intreaties of her relations, one of the fathers among the Jesuits was induced to intercede with the governor for her release. D'Avaugour, enraged to find that his salutary regulations were thus thwarted by those, who ought to have most vigorously seconded his injunctions, replied, in a paroxysm of passion, that, since the crime was not punishable in that woman, neither should it be so in any other person. He considered it as a point of honour not to retract his declaration; and, in consequence of the licence thus permitted in the disposal of ardent spirits, both the natives and the soldiery became so completely debauched, that all order and decency were disregarded, the clergy openly insulted, and the bishop compelled to embark for France, in order to lay his complaints before the king. Almost immediately after his departure, the whole system of nature in Canada appeared to have undergone a fatal revolution. The most tremendous hurricanes, earthquakes, thunderings, and fiery meteors, pervaded almost every quarter of the province, to a degree altogether unprecedented in that country. The largest trees were torn up by the roots, and the rivers turned out of their courses; mountains were overthrown from their foundations, and whole districts enveloped in flames, which issued from the bowels of the earth; the coasts were covered with sea monsters cast ashore, and every element, in short, seemed labouring to announce the dissolution of the world.* These awful calamities were so powerfully seconded by warnings and exhortations of the clergy, that a general reformation was effected, both among the French and Indian residents. The baneful commerce in spirituous liquors was universally proscribed; nothing was to be seen but penances, processions, and pilgrimages; and the affairs of New France began to assume an entirely new and highly promising appearance. The company of Canada, however, either unwilling or unable to support, any longer, so unprofitable a settlement, made a voluntary surrender of their rights to the French king in 1664, who entirely new modelled the government of the colony; but committed the trade of the country to the company *des Indes Occidentales*. Considerable reinforcements, both of troops and settlers, were sent from France. Numerous forts were erected along the lakes, to check the encroaching commerce of New England, to protect the Canadian traders in their excursions, and to keep the hostile Indians in awe. The attention of the French court was strongly attracted to its American possessions, by the able representation of M. Talon, intendant of Quebec; and it is from the active administration of this enlightened magistrate, that the province of New France dates its prosperity.

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* The following particulars of this remarkable event, extracted from the journal of the French Jesuits at Quebec, and first published in Lambert's *Travels in Canada*, (though rather to be regarded as a curious legend, than a creditable record,) may prove interesting to our readers. "It was on the 5th of February 1663, about half past five o'clock in the evening, that a great rushing noise was heard throughout the whole extent of Canada. This noise caused the people to run out of their houses into the streets, as if their habitations had been on fire; but, instead of flames and smoke, they were surprised to see the walls reeling backwards and forwards, and the stones moving, as if they had been detached from each other. The bells rang of their own accord. The roofs of the buildings bent down, first on one side, and then on the other. The timbers, rafters, and planks, cracked. The earth trembled violently, and caused the stakes of the palisades and palings to dance in a manner that would have been incredible, had we not actually seen it in several places. At that moment it was, that every one ran out of doors. Then were to be seen animals flying in all directions; children crying and screaming in the streets; men and women seized with affright, stood horror-struck with the dreadful scene before them, unable to move, and ignorant where to fly for refuge from the tottering walls and trembling earth, which threatened, every instant, to crush them to death, or sink them into a profound and immeasurable abyss. Some threw themselves on their knees in the snow, crossing their breasts, and calling upon their saints to relieve them from the dangers with which they were surrounded. Others passed the rest of this dreadful night in prayers; for the earthquake ceased not, but continued at short intervals, with a certain undulating impulse, resembling the waves of the ocean; and the same qualmish sensation, or sickness at the stomach, was felt during the shocks, as is experienced in a vessel at sea. The violence of the earthquake was greatest in the forests, where it appeared as if there was a battle raging between the trees, for not only their branches were destroyed, but even their trunks are said to have been detached from their places, and dashed against each other with inconceivable violence and confusion; so much so, that the Indians, in their figurative manner of speaking, declared, that all the forests were *drunk*. The war, also, seemed to be carried on between the mountains, some of which were torn from their beds and thrown upon others, leaving immense chasms in the places from whence they had issued; and the very trees, with which they were covered, sunk down, leaving only the tops above the surface of the earth. Others were completely overturned, their branches buried in the earth, and the roots only remained above ground. During this general wreck of nature, the ice, upwards of six feet thick, was rent and thrown up in large pieces; and from the openings in many parts, there issued thick clouds of smoke, or fountains of dirt and sand, which spouted up to a very considerable height. The springs were either choked up or impregnated with sulphur. Many rivers were totally lost; others were diverted from their course, and their waters entirely corrupted. Some of them became *yellow*, others *red*, and the great river of St Lawrence appeared entirely *white* as far down as Tadoussac. This extraordinary phenomenon must astonish those who knew the size of the river, and the immense body of water in various parts, which must have required such an abundance of matter to whiten it. They write from Montreal, that, during the earthquake, they plainly saw the stakes of the picketing, or palisades, jump up, as if they had been dancing; that, of two doors in the same room, one opened and the other shut of their own accord; that the chimneys and tops of the houses bent, like the branches of trees agitated by the

About the same time the Jesuit missionaries began to have at least more political success among many of the more distant savage tribes. Besides the Hurons, Algonquins, Outaouais, and particularly the Abenaquis, who had long been their allies, the Outagamis or Foxes, the Illinois, the Sioux, the Assiniboils, the Knistenaux or Creek Indians, the Nipissings, &c. were brought to a friendly intercourse with the colony. Many powerful chiefs, also, among the Onondagas or Onnontaguese, the Agniers, the Onneyouths, the Tsonnonthouans, and other nearer branches of the hitherto hostile Iroquois, became converts to Christianity, and were of the greatest service in attaching their countrymen to the French interest. But the colonists of New France, always intoxicated with the idea of their national greatness, were continually exciting the jealousy and hostility of their Indian neighbours, by attempting to treat them as subjects rather than as allies, or by endeavouring to gain advantages over them, through manœuvring and treachery; while, by imitating the savage practices of the natives in the field of battle, and wasting their strength in ill-concerted expeditions, they only exposed their own inferiority, and incurred the contempt of their enemies. Their trade with most of the Indian tribes was thus daily declining, while the influence of the English, on the contrary, was rapidly gaining ground; and hence it was resolved, in the year 1689, seriously to attempt the conquest of New York, as the only mean of securing the prosperity of Canada. The French court readily approved of the plan; and though a negociation was actually pending at the time, for adjusting the claims of the two nations in America, the government of Canada was authorized to make a secret expedition against the English, without any formal intimation of hostilities. The measure was as bloodily executed as it had been dishonourably devised; and, in a cowardly assault upon some of the settlements in New York, even the defenceless women and children

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wind; that, when they went to walk, they felt the earth following them, and rising at every step they took, sometimes striking against the sole of the foot and other things in a very forcible and surprising manner. From Three Rivers they write, that the first shock was the most violent, and commenced with a noise resembling thunder. The houses were agitated in the same manner as the tops of trees during a tempest, with a noise, as if fire was crackling in the garrets. The first shock lasted half an hour, or rather better, though its greatest force was properly not more than a quarter of an hour; and we believe there was not a single shock, which did not cause the earth to open more or less. As for the rest, we have remarked, that, though this earthquake continued almost without intermission, yet it was not always of an equal violence. Sometimes it was like the pitching of a large vessel, which dragged heavily at her anchors; and it was this motion, which occasioned many to have a giddiness in their heads, and qualmishness at their stomachs. At other times, the motion was hurried and irregular, creating sudden jerks, some of which were extremely violent, but the most common was a slight tremulous motion, which occurred frequently with little noise. Many of the French inhabitants and Indians who were eye-witnesses of the scene, state, that a great way up the river of Trois-rivieres, about 18 miles above Quebec, the hills, which border the river on either side, and which were of a prodigious height, were torn from their foundations, and plunged into the river, causing it to change its course, and spread itself over a large tract of land recently cleared: the broken earth mixed with the waters, and, for several months, changed the colour of the great river St Lawrence, into which that of Trois-rivieres disembogued itself. In the course of this violent convulsion of nature, lakes appeared where none ever existed before; mountains were overthrown, swallowed up by the gaping earth, or precipitated into adjacent rivers, leaving in their place frightful chasms or level plains. Falls and rapids were changed into gentle streams; and gentle streams into falls and rapids. Rivers, in many parts of the country, sought other beds, or totally disappeared. The earth and the mountains were violently split and rent in innumerable places, creating chasms and precipices, whose depths have never yet been ascertained. Such devastation was also occasioned in the woods, that more than a thousand acres, in one neighbourhood, were completely overturned; and where, but a short time before, nothing met the eye but one immense forest of trees, now were to be seen extensive cleared lands, apparently just turned up by the plough. At Tadoussac, about 150 miles below Quebec, on the north shore, the effect of the earthquake was not less violent than in other places, and such a heavy shower of volcanic ashes fell in that neighbourhood, particularly in the river St Lawrence, that the waters were as violently agitated as during a tempest. Near St Paul's bay, about 50 miles below Quebec, on the north shore, a mountain, about a quarter of a league in circumference, situated on the shore of the St Lawrence, was precipitated into the river; but, as if it had only made a plunge, it arose from the bottom, and became a small island, forming with the shore a convenient harbour, well sheltered from all winds. Lower down the river, towards Point Allonettes, an entire forest, of considerable extent, was loosened from the main land, and slid into the river St Lawrence, where the trees took fresh root in the water. There are three circumstances, however, which have rendered this extraordinary earthquake particularly remarkable. The *first* is *its duration*, it having continued from February to August, that is to say, *more than six months, almost without intermission*. It is true, the shocks were not always equally violent. In several places, as towards the mountains behind Quebec, the thundering noise and trembling motion continued successively for a considerable time. In others, as towards Tadoussac, the shocks continued general for two or three days at a time, with much violence. The *second* circumstance relates to the *extent* of this earthquake, which we believe was universal throughout the whole of New France; for we learn, that it was felt from *l'Isle Percée* and *Gaspé*, which are situated at the mouth of the St Lawrence, to beyond Montreal; as also in New England, Acadia, and other places more remote. As far as it has come to our knowledge, this earthquake extended more than 600 miles in length, and about 500 in breadth. Hence, about 180,000 square miles of land were convulsed at the same day, and at the same moment.† The *third* circumstance which appears the most remarkable of all, regards the extraordinary protection of Divine Providence, which has been extended to us and our habitations; for we have seen near us the large openings and chasms, which the earthquake occasioned, and the prodigious extent of country, which has been either totally lost, or hideously convulsed, *without our losing either man, woman, or child*, or *even having a hair of their head touched*."

† It was afterwards found to have extended through Upper Canada, where it overturned a chain of free-stone mountains, more than 300 miles in length.

were cruelly put to the sword. The English being thus well advertised of the inveteracy of their enemy, soon discovered, on their part, that the reduction of New France was equally essential to the existence of their colonies; and from this period to the final conquest of Canada, the history of that province exhibits a continued and systematic struggle between the French and English colonies in North America, to enlarge their Indian alliances, to extend their share in the fur-trade, to encroach upon each other's boundaries, and to hasten the complete subjugation of the rival settlement.

It would not be easy, and it is now altogether immaterial, to ascertain the justice of their respective claims, and alleged reasons of invasion. It may be mentioned, however, in general, that the English had fairly bargained and faithfully purchased from the Indians the greater part of their territories; and that, therefore, they had a just title both to claim a property in the lands themselves, and to regard as subjects of Great Britain, those savage tribes who remained upon the soil, under the protection of their government. They enforced this claim, however, so gently, that the Indians, while they enjoyed the greatest advantages, experienced no sense of subjugation, but were always treated as a free and independent nation, even while receiving pay as auxiliaries in the field. The French, on the other hand, claimed a direct dominion over all the native tribes in North America, and even over such as, by long residence, had become naturalized subjects of Britain; because, as they alleged, they were the descendants of nations who had formerly submitted to the government of France. They, of consequence, represented all the English settlements in North America, as absolute usurpations and encroachments upon their territories; and they are accused of having supported these unjust pretensions by equally unwarrantable means, by inventing boundaries, by changing the names of places, and even by delineating charts with such fictitious longitudes and latitudes, as best suited their views. It would be idle to pretend, that the English and their allies were wholly guiltless of excesses in the course of hostilities between those rival colonies; but the French and their Indian associates are unquestionably chargeable with such barbarities, as no civilized and Christian people could have been conceived capable of countenancing; and these were frequently committed, also, in defiance of express stipulations, treaties, and promises of protection. As a striking instance, or satisfying proof of this assertion, it is sufficient to adduce the inhuman conduct of the French General Montcalm, in quietly permitting, if not authorizing, the massacre of the garrison of Fort William Henry, in the year 1757. As this horrid butchery is altogether unparalleled in modern warfare, except perhaps among the savages of Russia,* and as an authentic account of its particulars has been given by an eye-witness, it may deserve a place in this sketch of North American annals. "In consideration of the gallant defence the garrison had made, they were to be permitted to march out with all the honours of war, to be allowed covered waggons to transport their baggage to Fort Edward, and a guard to protect them from the fury of the savages. The morning after the capitulation was signed, as soon as day broke, the whole garrison, now consisting of about 2000 men, besides women and children, were drawn up within the lines, and on the point of marching out, when great numbers of the Indians gathered about and began to plunder. We were at first in hopes that this was their only view, and suffered them to proceed without opposition. Indeed it was not in our power to make any, had we been so inclined; for, though we were permitted to carry off our arms, yet we were not allowed a single round of ammunition. In these hopes, however, we were disappointed; for presently some of them began to attack the sick and wounded, when such as were not able to crawl into the ranks, notwithstanding they endeavoured to avert the fury of their enemies by their shrieks and groans, were soon dispatched. Here we were fully in expectation, that the disturbance would have concluded, and our little army began to move; but in a short time, we saw the front division driven back, and discovered, that we were entirely encircled by the savages. We expected every moment, that the guard, which the French, by the articles of capitulation, had agreed to allow us, would have arrived and put an end to our apprehensions; but none appeared. The Indians now began to strip every one, without exception, of their arms and clothes; and those, who made the least resistance, felt the weight of their tomahawks. I happened to be in the rear division; but it was not long before I shared the fate of my companions. Three or four of the savages laid hold of me, and whilst some held their weapons over my head, the others soon disrobed me of my coat, waistcoat, hat, and buckles, omitting not take from me what money I had in my pocket. As this was transacted close by the passage, that led from the lines on to the plain, near which a French centinel was posted, I ran to him, and claimed his protection; but he only called me an English dog, and thrust me with violence back again into the midst of the Indians."—"By this time the war-hoop was given, and the Indians began to murder those that were nearest to them without distinction. It is not in the power of words to give any tolerable idea of the horrid scene that now ensued; men, women, and children were dispatched in the most wanton and cruel manner, and immediately scalped. Many of the savages drank the blood of their victims, as it flowed warm from the fatal wound. We now perceived, though too late to avail us, that we were to expect no relief from the French; and that, contrary to the agreement they had so lately signed to allow us a sufficient force to protect us from their insults, they tacitly permitted them; for I could plainly perceive the French officers walking about, at some distance, discoursing together with apparent unconcern."—"As the circle, in which I stood inclosed, by this time was much thinned, and death seemed to be approaching with hasty strides, it was proposed by some of the most resolute, to make one vigorous effort, and endeavour to force our way through the savages, the only probable method of preserving our lives, that now remained. This, however desperate, was resolved on; and about twenty of us sprung at once into the midst of them. In a moment we were all separated; and what was the fate of my companions I could not learn, till some months after, when I found that only six or seven of them effected their design. Intent only on my own hazardous situation, I endeavoured to make my way through my savage enemies in the best manner possible."—"Some I overturned, being at that time young and athletic, and others I passed by, dexterously avoiding their weapons; till, at last, two very stout chiefs of the most savage tribes, as I could distinguish by their dress, whose strength I could not resist, laid hold of me by each arm, and began to force me through the crowd."—“ But, before we had got many yards, an English gentleman of some distinction, as I could discover by his breeches, the only covering he had on, which were of fine scarlet velvet, rushed close by us. One of the Indians instantly relinquished his hold, and, springing on this new object, endeavoured to seize him as his prey; but the gentleman being strong, threw him on the ground, and would probably have got away, had not he, who held my other arm, quitted me to assist his brother. I seized the opportunity, and hastened away to join another party of English troops, that were yet unbroken and stood in a body, at some distance; but before I had taken many steps, I hastily cast my eyes towards the gentleman, and saw the Indian's tomahawk gash into his back, and heard him utter his last groan. I had left this shocking scene but a few yards, when a fine boy, about twelve years of age, that had hitherto escaped, came up to me, and begged that I would let him lay hold of me, so that he might stand some chance of getting out of the hands of the savages. I told him, that I would give him every assistance in my power, and to this purpose bid him lay hold; but in a few moments he was torn from my side, and by his shrieks I judged was soon demolished."—“ It was computed, that 1500 persons were killed or made prisoners by these savages during this fatal day. Many of the latter were carried off by them, and never returned. A few, through favourable accidents, found their way back to their native country, after having experienced a long and severe captivity."—“ That the unprovoked cruelty of this commander was not approved by the generality of his countrymen, I have since been convinced by many proofs. One only, however, which I received from a person, who was witness to it, I shall at present give. A Canadian merchant, of some consideration, having heard of the surrender of the English fort, celebrated the fortunate event with great rejoicings and hospitality, according to the custom of that country; but no sooner did the news of the massacre, which ensued, reach his ears, than he put an immediate stop to the festivity, and exclaimed, in the severest terms, against the inhuman permission; declaring, at the same time, that those who had connived at it, had thereby drawn down on that part of their king's dominions the vengeance of heaven." (See Carver's *Travels in North America*, p. 316, &c.) It has been alleged, in extenuation of this bloody transaction, that it was impossible to restrain the fury of the Indians; but it will not be easy to convince the world, that a body of 10,000 Christian troops could not have prevented the massacre from becoming so general; and there is a practical proof of the contrary, in the conduct of Sir William Johnson in the invasion of Canada, who made such unwearied exertions to keep the Indians, in the English army, within the bounds of humanity, that not a peasant, woman, or child was hurt by them, or even a house burnt, while they were in the enemy's country.

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* Or the allies of Britain at the river Raisin, in January, 1813. [MEASE.]

It would occupy too large a space of the present article to attempt a detailed account of even the principal expeditions and occurrences, in the course of this contest for existence, between the rival colonies; but it may be remarked in general, as a very unaccountable circumstance, that the province of Canada, which was so thinly inhabited and so poorly provided, should have been able to withstand, for such a length of time, the whole power of the English settlements; which, in addition to their decided superiority by sea, were able to bring five times the number of fighting men into the field. The frequent discomfiture and tardy progress of the British forces, may be ascribed chiefly to the inexperience of their commanders in the American mode of warfare, to the endless dissensions between the provinces and their governors, and to the prevalence of personal animosities and of private interests among those who should have united in the service of their country. About the year 1758, however, the arms of Great Britain began to be attended with better success in North America; and it ought to be recorded, that Sir William Johnson, by his good conduct as a commander, as well as by his extraordinary influence with the Indians as a negociator, was eminently instrumental in giving this favourable turn to the state of affairs, and in preparing the way for the final subjugation of Canada. The operations of the campaign, for this purpose, were directed in three different quarters, so as gradually to approach each other, and at length to unite in one point. General Wolfe, with 8000 men, was appointed to undertake the siege of Quebec. General Amherst, at that time commander in chief of the forces in America, was directed, with 12,000 men, to reduce Ticonderoga and Crown-point, and then crossing Lake Champlain, to co-operate with General Wolfe. Brigadier General Prideaux, assisted by Sir William Johnson's abilities and advice, was commissioned to attack fort Niagara, and thence to proceed to form a junction with the other commanders, for the siege of Montreal. These three different divisions, by a wonderful concurrence of favourable circumstances, accomplished their respective objects; and actually met at the walls of Montreal, within twenty-four hours of each other. A more particular account of their progress and exploits has already been given in the article America; and we have only to mention the general result in this place. By the capitulation of Montreal on the 7th of September, 1760, the reduction of Canada was completed; and it was finally ceded to Great Britain, by the definitive treaty of peace in 1763. The province was found by the conquerors in a very impoverished condition; and the inhabitants, in many places, were supplied with provisions from the stores of the army. For several years after the conquest, the country continued in a very unsettled state; and presented innumerable obstacles to the British traders. The Indian tribes, either not considering the French government as sufficiently authorised to transfer their allegiance to Great Britain, or excited against their new masters by the Popish missionaries, who resided among them, carried on, for some time, a desultory and destructive warfare; rendered all intercourse with the interior extremely hazardous; and prevented the extension of settlements, either for the purposes of trade or cultivation. The most formidable confederacy of the natives was directed by a celebrated Indian warrior named Pontiac, who had always been strongly attached to the French interest. In the year 1763 he took by surprise fort Michillimackinac, which is situated between the lakes Huron and Michigan; but treated the garrison with considerable humanity. In the following year, he made a similar attempt against fort Detroit, between lake Erie and lake St Clair; but having been thwarted in his designs, and the garrison having received a considerable reinforcement, he proposed an accommodation, concluded a peace, and received a pension from the British government, as the purchase of his friendship. The confederate Indians soon after returned to their different provinces, and gradually became reconciled to the conquerors of the country.

Previous to the year 1664, the supreme authority in Canada was entirely military; and the will of the governor was the sole fountain of justice. At that period, a code of laws, founded upon the practice in Paris, was given to the colony, and a council of state was established in the capital. This council consisted of the governor, the bishop, the intendant, four counsellors chosen by these three, a procurator general, and a chief secretary. This constitution afterwards underwent various alterations. The number of counsellors was gradually increased to twelve, and the subaltern judges to so great a multitude, that a litigious spirit began to prevail among the colonists, from the influence of which they have continued to suffer even to the present day. During the first four years after the conquest of Canada by the British, it was divided into three military governments, and the officers of the army acted in the double capacity of commanders and judges. The laws of England, however, were soon established in the province; and its criminal code particularly, was speedily experienced to be an inestimable benefit, in comparison with the tyrannical and summary proceedings of the French system. But the English civil laws were not received with equal approbation by the old colonists; and, in 1774, an act of the British legislature restored in their place the old *coutume de Paris*. A council was at the same time appointed, consisting of the lieutenant-governor, the chief justice, the secretary of the province, and 20 other members, chosen indifferently from the French and British residents, invested both with a legislative and executive authority, and possessing power to perform every act of government, except that of imposing taxes. This plan, however, was not greatly relished, either by the British emigrants, who thus found themselves deprived of some of the most valuable privileges which they had enjoyed in their own country, or by the Canadian inhabitants, who had begun to relish the advantages of a free government. Hence, in 1791-2, all the benefits of the British constitution were extended to this part of the empire. The colony was divided into two distinct provinces, called the Upper and Lower. A legislative council and an assembly were constituted in each, having power, with the consent of the governor, to make laws, which should not be contrary to the acts of the British parliament; but the king has a right to declare his dissent at any time within two years after receiving the bill. The legislative council of the upper province must consist of at least seven members, and that of the lower of 15; which numbers, however, may be augmented at the king's pleasure, and has been recently increased to twenty-one. These are summoned by the governor under the royal authority, and are nominated for life, unless they forfeit their seats by an absence of four years, or by paying allegiance to a foreign power. The house of assembly in Lower Canada consists of 50 members, and in Upper Canada of 16, who are chosen by the freeholders in the towns and counties. In the counties, the electors must be possessed of landed property to the clear yearly value of 40 shillings or upwards; and, in the towns, must possess a dwelling-house and lot of ground to the yearly value of 5*l.* sterling; or must have paid, for one year at least, a rent of 10*l.* per annum. These councils must be assembled once, at least, every twelve months; and the houses of assembly continue four years at most, but are subject to be dissolved before the termination of the full period. The governor, together with such of the executive council as may be appointed by the king, for the affairs of each province, are to act as a court of civil jurisdiction for hearing and determining appeals; subject, however, to such appeals from their sentence as existed previous to the passing of the act appointing this constitution. The whole is superintended by an officer styled Governor General of the four British Provinces in North America; but each of them has a lieutenant-governor, who, in the absence of the governor-general, has all the powers of a chief magistrate.

It has been questioned, with considerable appearance of justice, whether the inhabitants of Canada were sufficiently prepared for such a full extension of the British constitution. The majority of the assembly in each province, especially in the Lower, are always of French descent; and have thus the power of passing such regulations, as may be most agreeable to their views; while, at the same time, they are in general very far from being properly qualified, by their degree of education, or habits of life, to discharge the office of legislators. The counties, though large, are so thinly inhabited, that they can very seldom furnish persons fitted to represent them. The few who might be competent to undertake the office, cannot easily leave their habitations and employments, without great detriment to their private interests. Hence it happens, that more than one half of the members of assembly, at least in Lower Canada, is composed of merchants, shopkeepers, lawyers, &c. residing in Quebec and Montreal. The Canadians themselves opposed, at first, the introduction of the present form of government; and it was procured chiefly by the application of British residents. But in order to have given the latter what they wished, the superiority in the government, as well as upon every principle, which renders a union desirable, there ought to have been only one house of assembly for both provinces.

For the more regular administration of justice, Lower Canada was, in 1794, divided into three districts: that of Trois Rivieres, in which there is only one judge; that of Quebec, in which there is one chief justice, three puisne judges, and a solicitor general; and that of Montreal, in which there is the same number as in Quebec, with an attorney general; but both the solicitor and attorney general are competent to attend the several courts throughout the province; and, unless prevented by unavoidable absence, the attorney general conducts all criminal suits in each of the districts. The upper province is considered as only one district; and has one chief justice, with three puisne judges. The chief justices are always British.

There are about 60,000 militia in Canada, but they are neither well clothed nor trained. The English and the Canadians also are distributed into separate corps, while the latter are both officered by their own people and taught their exercise in French, so as to be utterly incapable of acting in the same brigade with British troops.

The revenues of Lower Canada, consist of the casual and territorial revenue of the crown prior to the conquest, which has been given up by his majesty in aid of the civil expences of the province. This arises from *ledroit de quinte les lods et ventes*, (duties paid upon the sale of property), rent paid for the king's posts on the Labrador coast, and for the forges of St Maurice. To these are to be added certain permanent and moderate duties, (imposed either by acts of the British parliament prior to the constitutional act of the year 1791, or by those of the provincial legislature,) on wine, spirits, tea, and a few other articles imported into Canada. The whole taken together, produce from 30,000*l.* to 35,000*l.* a year; and nearly suffice for the *ordinary* expences of the civil government, any deficiencies being made good from the military chest. Duties, to nearly the same amount, are also collected under temporary acts of the provincial legislature, and applied to particular purposes, such as the building of court houses, gaols, &c. The expences of the Indian department of the two Canadas, including the salaries of the officers, and what is paid in England for goods sent out as presents to the Indians, (who are treated by the British government as military allies), amount, on an average, to about 25,000*l.* per annum; and are regularly included in a vote of parliament, and defrayed out of the army extraordinaries. But the surplus expence of Great Britain in supporting Canada is well repaid by the consumption of her manufactures, the employment given to her seamen, the supplies afforded to her West India islands, and the variety of useful productions which she imports from the colony.

The external appearance of Canada, like that of North America in general, is altogether of the majestic character; and inanimate nature is there exhibited on the grandest scale. Every thing is vast and sublime. Lakes, that can be compared only to seas; rivers of immense and amazing velocity; cataracts of inconceivable magnificence; mountains and forests apparently interminable, are every where presented to the view, in continued succession and inexhaustible variety. In the districts of Upper Canada there are plains of great extent and beauty; but the general and ordinary prospect throughout the country is that of mountainous ridges, rising behind each other, stretching in all directions, and completely covered with wood; so that the cultivated parts appear like a few islands scattered upon the surface of the ocean; and are almost wholly lost to the view, except in the neighbourhood of the towns, where the scenery is rich and pleasing, presenting a beautiful mixture of cottages and corn fields, of villages and country residences. On entering the St Lawrence, a continued forest appears down to the very brink of the water; but the trees are there rather dwarfish and scraggy, more like brushwood than timber. On both sides, are mountains of immense height, which frequently terminate in acute pointed capes; and from the bottom of these to the edge of the river lies a level tract of land gradually advancing to general cultivation.

The great river of Canada, the St Lawrence, is universally regarded as the second, and may even be affirmed to be the first, on the face of the globe. Its length, if reckoned from the egress of lake Ontario, is 700 miles; but if computed from lake Superior, is not less than 2500. But the greatness of its breadth, and the extent to which it is navigable, form its distinguishing characteristics. It is 90 miles wide at its mouth, where it is divided into two channels by the island of Anticosti, which is 120 miles long and 30 broad, barren and of little value, and occupied only in winter by a few savages for the purposes of the chase. It is navigable for ships of the line nearly 400 miles from its mouth; for ships of considerable size, as high as Montreal; while ships of the largest class may be navigated on the lakes, through which it flows, at a distance of 2000 miles from its junction with the ocean. It receives in its progress an innumerable multitude of smaller rivers, and several of considerable magnitude. These tributary waters flow chiefly from the north; and the most remarkable are, the *Saguenay*, a very deep and impetuous torrent, about three miles in breadth, except at its mouth, bounded by high and precipitous banks, sometimes 600 and even 1000 feet in height, taking its rise from lake St John, flowing through a course of 150 miles, interrupted by numerous falls in its progress, and falling with a contracted stream, but with a powerful impulse, into the waters of the St Lawrence at Tadoussac;—the *Montmorency*, which also flows from the north, abounds in cascades, and meets the St Lawrence, about eight miles to the eastward of Quebec;—the *Chaudiere*, which flows from lake Megantic, through a course of 120 miles, and falls into the St Lawrence about eight miles to the south-west of Quebec, where its mouth is completely confined by thick woody banks;—the *St Ann*, a stream of considerable size flowing from the north coast, and abounding in falls;—the *Jaques Cartier*, which falls in about 30 miles above Quebec, and which sweeps its broken current with great impetuosity over a very rocky bed;—the *Sorel* or *Chambly*, arising from lake Champlain, and flowing through a very fertile tract of country; the *Olaouais*, or *Utawas*, or Grand river, the largest of all these tributary streams, issuing from various lakes in the centre of Upper Canada, rushing over a bed of remarkable declivity, and pouring its waters, of a bright greenish colour, into the muddy bosom of St Lawrence, a few miles above Montreal.

The numerous and magnificent cataracts, which are to be found in this country, are its greatest natural curiosities. In most of these falls, there is indeed a considerable similarity in point of effect, as the precipices, over which they are thrown, are nearly perpendicular; but, still, each of them is distinguished by some peculiar features of the sublime, the wild, and the picturesque. The cascades and rapids are innumerable; and are to be found, in all the variety of romantic beauty, in almost every stream that flows into the St Lawrence. The following appear to be the most worthy of particular notice:—The falls of *St Thomas*, which are extremely beautiful, and about 25 feet in height;—of *St Charles*, a very romantic cataract of 30 feet, near the lake of the same name;—of *Saguenay*, at the mouth of that river, about 50 feet high, forming an immense sheet of water, which is so perpetually broken in its descent, as to assume a resplendent white appearance;—of *St Ann*, which are seven in number, very near to each other, the largest of which is about 130 feet high, and is surrounded with remarkably rugged steep woody banks; of *La Puce*, the chief of which is 112 feet in height, and is so completely clothed with wood, to the very summit of the precipice, as to produce a very deep and solemn gloom; of the *Chaudiere*, about four miles from the mouth of the river, about 360 yards broad, descending from a height of 120 feet, in three distinct cataracts, surrounded with wood, and abounding in the wildest and most picturesque scenes;—of *Montmorency*, exactly at the confluence of that river with the St Lawrence, about 200 feet in breadth, falls in one undivided mass from a perpendicular height of 246 feet, and having few trees on its steep and lofty banks, is more remarkable for grandeur than for beauty;—and of *Niagara*, between lakes Erie and Ontario, 600 yards wide, divided by two islands into three distinct cataracts, one of which is 142 and another 160 feet high, the noise of which is heard to the extent of 15 miles, and the cloud of vapour, which they throw up, is said to be frequently observable at a distance of 90 miles. Those who have witnessed this stupendous cataract, declare that no power of words can convey an adequate idea of its sublimity. "The lofty banks and immense woods," says Mr Heriot, "which environ this stupendous scene, the irresistible force, the rapidity of motion displayed by the rolling clouds of foam, the uncommon brilliancy and variety of colours and of shades, the ceaseless intumescence and swift agitation of the dashing waves below, the solemn and tremendous noise, with the volumes of vapour darting upwards into the air, which the simultaneous report and smoke of a thousand canon could scarcely equal, irresistibly tend to impress the imagination with such a train of sublime sensations, as few other combinations of natural objects are capable of producing." See also NIAGARA, and Weld's *Travels in Canada*, vol. ii. p. 123.

The lakes of Canada are astonishingly numerous, and the waters still cover so large a portion of its surface, as almost to afford a proof of its being more recently deserted by the ocean, than the rest of the American continent. Those in the direction of the St Lawrence, are by far the largest; and the first of these, that meets the navigator, as he ascends the stream, is that of *St Peter*, which is, properly speaking, nothing more than the expansion of the waters of the St Lawrence, over a level country, which is about 20 miles long, and 15 broad, receives a number of considerable rivers into its bed, and yet is so extremely shallow, that the ship-channel, at some seasons, is not more in many places than 11 or 12 feet deep.—Lake *Ontario*, or *Cataraguy*, the smallest of the five great lakes, is of an oval figure, 160 miles in length, and about 450 in circumference. Its depth in many places, is not ascertained; and it has frequently been sounded with a line of 350 fathoms, without finding the bottom. It contains an immense number of islands, and is very liable to be agitated by stormy winds. The soil around its borders is very much intermixed with rocks, and yields several valuable quarries of a durable white stone. Various volcanic productions are found on its banks; and this circumstance, in conjunction with its immeasurable depth, has given rise to a conjecture, that its basin was once the crater of a volcano. See Volney's *View of the United States*, p. 120.—Lake *Erie*, or *Oswego*, is 300 miles in length, 40 at its utmost breadth, 710 in circumference, and about 50 fathoms at its greatest depth. At its northern extremity, it is much exposed to violent gales, and its navigation is both tedious and dangerous. It contains, towards the west, a number of beautiful islands, in which are many remarkable caverns abounding in curious stalactites. These islands are also full of reptiles, especially rattlesnakes; and the margin of the lake is in many places completely covered, for many acres, with the large leaves of the pond lily, upon which, in the summer season, myriads of water snakes are seen basking in the sun. The bottom is a bluish limestone rock, and its banks are clothed with wood, abounding in game and wild animals.—Lake *Huron*, the second in point of magnitude, is of a triangular form, 250 miles in length, and 1100 in circumference. It contains a number of islands, among which, one called Manataulin, signifying the place of spirits, and held sacred by the Indians, is nearly 100 miles long, and 8 in breadth. It has also numerous and extensive bays, one of which, Saguina, or Saganaum, is 15 miles long, and 18 wide; and another about 9 miles broad, called Thunder Bay, because it is scarcely ever free from tremendous thunder storms. The storms on this lake are extremely dangerous, and its waves both rise higher, and break quicker than those of the ocean. It contains abundance of large white fish, and particularly a rich and delicate trout, some of which are four or five feet in length, and frequently 70lb. in weight.—Lake *Michigan* is situ ted entirely within the American territories, but as, together with lakes Huron and Superior, it forms what ha been called the *Sea of Canada*, it seems entitled to a shor notice in this sketch of the principal lakes of that country. It is about 280 miles long, 70 at its greatest breadth, and 945 in circumference. On its eastern coast it receives a number of rivers, the banks of which abound in *ginseng* On its northern coast is the Green bay, or bay *des Puan* , 120 miles long and 30 wide, the waters of which have a considerable flux and reflux; and the quantity of mud which they leave behind causing an unpleasant vapour, when exposed to the sun, has occasioned its French name *Puante*. From this bay there is a short and easy communication with the Mississippi. It communicates also with Lake Huron, by the straits of Michillimackinac; and though no diurnal ebb or flow is perceptible in the waters of this passage, yet it is affirmed, that a periodical alteration takes place in their height; that in the course of seven years and a half, they gradually rise about three feet, while, in the same space of time, they as imperceptibly fall away to their former state.—Lake *Superior*, or *Tracey*, or *Condé*, is the largest body of fresh water on the face of the earth, being 400 miles in length, 100 at its greatest breadth, and nearly 1600 in circumference. I receives the waters of nearly 40 rivers, some of which are of considerable magnitude; and contains a number of islands, one of which, *Isle Royale*, is about 100 miles long and 40 broad. Its bed is covered with large uneven rocks, and is in many places beyond the reach of soundings. Its northern banks are very high and rugged, and abound in virgin copper; but its eastern shore is low and shallow, covered with stunted trees and brambles, and producing an amazing quantity of currants, strawberries, whortleberries, and raspberries, of extraordinary size and delicious flavour. The soil, however, around the greater part of the lake, is extremely barren, yielding indeed abundance of meadow hay, but scarcely bearing any other kind of crop than potatoes. It abounds in sturgeon and long trout, from 50 to 70 pounds in weight; and, owing to the unequalled transparency of its waters, these fish are seen to an astonishing depth from its surface. It is subject to tremendous storms; and there is a swell upon its coast resembling the flow of the tide. Its waters have been observed to vary in their height at particular periods from five to six feet; which is supposed to be occasioned by the greater or smaller quantity of snow in the adjacent regions, by the dissolution of which its tributary streams are supplied. This lake may be considered as the grand reservoir of the river St Lawrence, as no other large river flows from its bosom; but as it does not appear that one tenth part of the waters, which are conveyed into it by 40 channels, are carried off at this one point of evacuation, it remains yet to be ascertained by what cause, whether by evaporation, or by subterranean cavities, the superabundant fluid is removed. It communicates with Lake Huron by the Straits of St Mary, which are rendered unnavigable for boats of any burden by the rapids. The North-West company, however, have cut a canal along the northern bank, for the purpose of facilitating their commerce, and have here a considerable establishment; but their principal fort and storehouses are situated at Kamenistiquia, upon the banks of a river which flows into the north-west of Lake Superior, and which affords them an easy communication with the interior.

Of the immense multitude of smaller lakes which cover the inland parts of Canada, it is only a very short view of the most remarkable that can here be given. Farther west are, the *Lake of the Woods*, which has its name from the quantity of wood on its banks, is of an oval form, about 75 miles long and 40 broad, with a muddy bottom, and in some places of great depth; Lake *Winipic*, or *Ouinipique*, the reservoir of several large rivers which discharge themselves into Hudson's Bay, is about 200 miles long, and 100 broad, full of small islands, and well stored with fish, bounded on the north side with banks of black and grey rocks, and on the south with a low and level country; Lake *Bourbon*, formed by the waters of the river Bourbon, which runs a great way southward, near to the northern head of the Mississippi, is about 80 miles long, and nearly as much in breadth; *Lake of the Hills*, or Lake *Athabasca*, or *Great Slave Lake*, from which Mackenzie's river extends its course to the Arctic Ocean, is about 200 miles in length, and 100 in breadth, and scarcely within the boundaries of Canada. On the north of the St Lawrence, the principal lakes are, Lake *Manikaugamich*, at the head of the black river, which falls into the St Lawrence to the east of Saguenay, near the coast of Labrador, and which is about 60 miles in circuit; Lake *St John*, on the river Saguenay, about 90 miles in compass, and bordered with pine trees; Lake *Mistassin*, at the head of Rupert's river, very irregular in its shape, but nearly 200 miles in circumference; Lake *Temiscaming*, on the Utawas river, which falls into the Cataraqui; and Lake *Nipising*, on the French river, which runs into Lake Huron, about 100 miles each in circumference. On the south of the St Lawrence, the only one worth mentioning is Lake *Champlain*, at the head of the river Chambly or Sorel, and almost entirely within the territories of the United States. It is 120 miles in length and 15 in breadth, well stored with fish, and situated in the midst of a beautiful and fertile country.

The mountains of Canada have never been properly examined, either with a view to describe their ranges, or to ascertain their structure. The principal ridge is in the northern part of the province, in the direction of south-west and north-east, giving rise to many rivers, which flow chiefly to the south-east. There are few mountains towards the south-west of the colony; but between Quebec and the sea, they are more numerous. The whole extent of Canada may be considered as a granitic country, occasionally accompanied with calcareous rocks of a soft texture, and in horizontal strata. The region of the calcareous stones seems to extend in a line north-west, beyond Lake Michigan, as far as the sources of the Mississippi, and thence to those of the Saschachawin, joining at length the great chain of the Stony or Chipewyan mountains, which again may be considered as a continuation of the Cordillera of the Andes. All the great lakes of Upper Canada are placed in the line of contact between those two vast chains of granite and limestone. At the narrowest part of lake Winnipeg, for instance, where it is not more than two miles broad, the west shore is skirted by calcareous rocks, about 30 feet high, while, on the opposite shore, there are still higher rocks of a dull grey granite. In the lower province, particularly, the granite predominates. A calcareous stratum, indeed, found under the St Lawrence at the fall of Niagara, seems to proceed along the bed of the river as far as Quebec; the isle, on which the city of Montreal is built, is of a calcareous nature; the immediate bed of the fall of Montmorency is a horizontal shelf of a black grey limestone, of the kind called primitive or crystallized; and the banks of the St Lawrence, as also of the other rivers in Lower Canada, are chiefly composed of a schistous substance, generally in a decayed and mouldering condition. But still in every quarter, even among these other substances, the granite is found in strata, more or less inclined to the horizon, but never parallel with it. There are veins of lead ore near the bay of St Paul, north-east of Quebec, which yield a few grains of silver. A considerable quantity of iron ore is found in the neighbourhood of Trois Rivieres; and copper on the south-west of Lake Superior. No coal has yet been discovered in Canada, but it is supposed to exist in the environs of Quebec, and is known to abound in Cape Breton.

The soil of Lower Canada consists of a light and loose blackish earth, ten or twelve inches deep, lying upon a stratum of cold clay, very fertile, but soon exhausted, unless regularly recruited by a supply of manure. The best of it is generally found on the banks of those rivers which flow into the St Lawrence, especially the Ouelle, de Sud, Chambly, and de Loup. That of the upper province, however, is greatly superior, and the country much more level, and better adapted for cultivation. In Canada there can scarcely be said to be more than two seasons of the year, summer and winter. The snow has scarcely disappeared, when the heat of summer is experienced; and the season of vegetation is prolonged through the autumn months, till suddenly checked by the rapid return of winter. The range of the thermometer is very extensive, seldom less than 120 degrees, generally rising in summer to 92, and frequently falling in winter to 28 below zero; that is, from 60 above to 60 below the freezing point. At midsummer it has been observed occasionally as high as 96, and in winter as low as 40 degrees below zero; but the medium temperature in December and January is 22 below the freezing point. In the months of July and August, the heat is peculiarly oppressive; and in September the weather is most pleasant. In October and November, the snow begins to fall, and the frost becomes daily more severe. In December and January, winter reigns in all its majesty, and the cold is very intense; but the air, by means of the congelation of its aqueous particles, is uncommonly dry; and has not nearly so severe an effect upon the feelings as a moist atmosphere with a higher temperature. When the cold dry air enters a heated apartment, its drying power is astonishingly increased, and its effects upon the furniture are very surprising. In the course of a winter, the pannels of the doors frequently shrink so much, as almost to fall out of the frame, while the frame itself shrinks to such a degree, that the bolt loses its hold. In the month of March, the sky is clear, the sun shines bright, and his heat begins to be felt. In April, the influence of his rays is very considerable; and, in the first week of May, the snow has nearly disappeared, the ice on the rivers and lakes is broken up, the ground sufficiently soft for farming operations, and vegetation remarkably vigorous. In the settled parts of Upper Canada, the climate is greatly milder, and the winter of shorter duration, frequently passing without much frost, and sometimes with scarcely any snow.* Neither Lake

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* It is astonishing to read the absurdly false accounts published about the inconveniences of the climate of the United States, and the happiness enjoyed by the Canadian settler. Thus, in the article "AMERICA," p. 583, speaking of Virginia, it is said, that "Travellers relate, that after passing a sultry day, and retiring to rest, they have

Ontario, Lake Erie, Lake Huron, nor Lake Michigan, are subject to be frozen to any great distance from their coasts; but Lake Superior, from its more northerly situation, is usually covered with a solid body of ice for an extent of 70 miles from land. In the region to the north-west of Lake Superior, extending to the Stony Mountains, and then northwards to the latitude of 72°, the climate and soil are completely Siberian. The ground is generally flat, bare of trees, (unless here and there a few of stunted growth,) interspersed with lakes, marshes, and an infinite number of streams, and incessantly swept by stormy icy winds from the north-west. From the latitude of 46° the earth is frozen throughout the whole course of the year; and at several trading posts, between 50° and 56°, it was found impracticable to dig wells, even in the month of July, the earth being thawed only to the depth of three feet. In what may be called cultivated Canada, however, in the upper province, and especially towards the west, the climate bears a nearer resemblance to that of Europe, in the same latitudes; and there is very little difference to be found, except such as may proceed from the vicinity of high mountains covered with snow. The longer continuance of frost and snow in Lower Canada, for nearly six months in the year, has been attributed to the immense desert regions, which stretch towards the north; and it is chiefly when the wind blows from the north-east quarter, where the mountains of ice are found, that very great quantities of snow fall in that province. The utmost depth of snow in the woods, when it is not drifted by the winds, is usually six or seven feet; and the ice on the rivers generally acquires a thickness of two feet and upwards; but, on the borders of St Lawrence, it sometimes exceeds even six feet. The climate of the lower province, however, has been observed to be rapidly ameliorating; and by a meteorological table it has been ascertained, that in the space of fifty-eight years, the medium cold of its winter has lost eight degrees of its wonted severity in the neighbourhood of Quebec. The period also, at which the river St Lawrence is shut up by the ice, is nearly a month later than when Canada was first colonized. This has been ascribed to the clearing and cultivating of the lands, and it is not improbable that this cause may have had some small influence; but the tracts thus improved bear so small a proportion to the whole extent of the country, and this amelioration of the climate has also been so conspicuous even in those districts, which are still in an absolute state of nature, that it seems more rational to refer it to some more extensive and predominating operation in the system of nature. (See this subject discussed more fully in Volney's *View of the United States*, p. 266.) It has been mentioned also, (but whether to be considered as a cause or as an effect of this improvement of the climate, it is not very easy to ascertain,) that the inland waters are decreasing, and that many lakes are draining and filling up by the earth, which is carried down by the rivers from the higher grounds.

When the French commenced their settlements in Canada, the country presented the appearance of one vast unbounded forest, and great privileges were bestowed to encourage the colonists to attempt its improvement. The lands on each side of the St Lawrence, and of the rivers, which fall into its channel, for a space of nearly 300 miles in length, extending from 90 miles below Quebec to 30 above Montreal, were granted by the French king, in extensive lots, called *seigneuries*, to officers in the army, to companies or associations, and to such other individuals as possessed interest to procure them, and who thus became *seigneurs* or lords of the territory. These tenures were entirely of a feudal nature, held immediately of the king; and, upon every transfer of the property, the new purchaser paid a fifth part of the value to the receiver-general, who gave a receipt upon the title, and by this act invested him with the possession. These seigneuries occupied from 100 to 500 square miles; and the proprietors were bound to concede them in smaller lots to the settlers, upon certain conditions. These lots were very narrow in front, seldom extending along the course of the river more than three acres; but they stretched a considerable way, generally 80 acres, into the country. These grants, or concessions, were also of a feudal character; and the grantees were the vassals of their lords, as the lords were the vassals of the king. For these lots there is seldom any price given by way of purchase money; and the rent paid by each tenant is very inconsiderable, frequently not more than three livres. *(2s. 6d.)* a year, besides a bushel of wheat and a couple of fowls; but the seigneurs, who have many inhabitants on their lands, derive a handsome revenue, partly from these trifling rents, from the fees received at his mills, to which his tenants are bound to bring their grain, and from the fine which is due to him upon every transfer of the lots by sale or long lease. There are about 100 of these seigneuries in Lower Canada, all subject to French law; and the proprietors might have attained considerable affluence, had the estates been allowed to remain entire; but, according to the old French law, which is still in force in the colony, the property of every individual, who dies intestate, descends in certain proportions to his widow and children; and thus both the seigneuries themselves, and estates of much smaller extent, held in roture, have been so frequently subdivided, that many of the proprietors of the former retain little more than their title; while the greater part of the holders of the latter are so miserably poor, as to have neither capital nor spirit for agricultural undertakings. This law has been found to have a very hurtful effect, also, in a moral point of view, tending very much to weaken the natural affection, which should subsist between parents and children, as well as to introduce a general spirit of litigation into families. Since the conquest of Canada by the British arms, all those parts of the lower province, which had not been previously granted as seigneuries, have been surveyed by order of government, and divided into townships, which are about ten miles square, and are granted to individuals, to be held by the English tenure of *free and common soccage*. These are situated in the more retired parts on the south bank of the St Lawrence, between the rivers Chaudiere, St Francis, Yameska, and Chambly, extending to the 45th parallel of latitude, and subject, like the upper province, to the law of England. The persons to whom these townships are granted, are bound to cultivate a certain number of acres within a given time. The greater part of these lands lie contiguous to the territories of the United States; and are chiefly occupied by emigrants from thence, who, before obtaining their grants, have taken

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sometimes awakened at an early hour, benumbed with cold, and have found the part of the coverlet which was exposed to their breath, crusted over with solid ice:"—while in Upper Canada, the *winter sometimes passes with scarcely any snow.* There is no part of America north of Virginia to which such an observation will apply.

[Mease.]

the oath of allegiance to his Britannic majesty. They hold in general above 200 acres each; and are bound to keep open the highways passing through their possessions. The first step in the process of cultivation, is to build a log-hut, and open a road of communication with the nearest neighbours. They next proceed to clear the land of the wood, and this is done in various ways. One mode is, to cut down the timber, to dig out the roots, and then to burn the whole in heaps upon the ground; which, when thus laid open, is soon covered with vegetation, and capable of grazing cattle; but this method, besides being very tedious, is attended with great expence, and costs about thirty shillings per acre. The Americans have introduced a more simple and economical, and, at the same time, equally successful plan, viz. to cut down and burn the trees; and, after turning up the earth with a hoe or harrow, to sow the spaces between the standing roots. A third method is to set fire to the growing wood, to stop the growth of the larger trees, by cutting a deep circle in the bark, to sow the interstices with grain, and to remove the decayed timber at leisure. In these cases, when the underwood is thick, the blaze of the burning forest is truly awful, continues for weeks together, and often extends its progress far beyond the intended space. In clearing the ground, however, a certain portion of wood is always left standing, for supplying fuel and other domestic purposes; and these stripes of forest, while they serve as boundaries between the different lots, contribute to give, even to the cultivated districts, a wild and woody appearance. The usual condition upon which farms are let, are, that the proprietor furnish the cattle, supply the utensils of husbandry, and incur the expence of clearing, ditching, and fencing; the produce is then equally divided between the tenant and himself.

With the exception of a few cases, the Canadians are very deficient in agricultural skill. In consequence of the law before mentioned, their farms are small, and their capitals limited, so that they are not at all able to attempt experiments. They are also destitute of education, and ignorant of recent improvements; much inclined to indolent habits, and, like the peasantry of most countries, strongly averse to admit any innovations. It is only of late years, and to a very small extent, that they have begun to adopt the application of manure, the rotation of crops, and the use of artificial grasses. They have begun particularly to employ the marl, which is found in considerable quantities on the shores of the St Lawrence; but the general practice is to plough the same field, and sow the same grain, twenty times over; while the only remedy for land exhausted in this manner, is to leave them fallow for a few years. Seed-time commences about the 20th of April, and harvest early in August. The average produce of the soil in Lower Canada has been estimated at 25 to 1 for oats; 12 for barley; 6 for pease; and 11 for summer wheat. Barley, oats, Indian corn, and other ordinary kinds of grain, are produced in considerable quantities for home consumption, but seldom in such abundance as to supply exportation. It is but very lately indeed that barley has been known in Canada; and was introduced, with great difficulty, by a gentleman who had established a distillery at Quebec. That which is now produced, makes excellent malt; and considerable quantities of ale are exported to the West Indies. The soil and climate of Canada are very favourable to the growth of hops, of which enough is raised to supply the wants of the brewers, and which might easily be rendered an article of exportation. Hemp has begun to be cultivated with much success; and government has greatly encouraged the growth of that article. See on this subject, a paper by William Bond, Esq. in the 26th volume of the *Transactions of the Society for the encouragement of Arts*, &c.

At the time when Canada was first discovered, the inhabitants of Europe were so entirely engrossed with the acquisition of those precious metals, which had been imported from Mexico and Peru, that no country, in which these were not produced, was considered as deserving of any attention. It was soon understood, that no mines were to be found in that quarter of North America; and hence the colony of New France fell into complete disrepute, before a proper knowledge could be acquired of its soil and productions. This early prepossession to its disadvantage was the principal source of the future discouragements and obstacles, with which its commerce had to struggle; and it never attained any degree of prosperity, as long as it remained in the hands of the French. It sustained very great injury, also, by the frequent alterations which took place in the medium of exchange, especially by the inconveniences which resulted from the introduction of card or paper money. In 1706, the whole trade of the colony was carried on with a fund of 650,000 livres, distributed among a population of 30,000 inhabitants. During seven years of its most flourishing period, previous to its conquest by the British, its annual imports were valued only at 160,000*l.*, sometimes at 240,000*l.*; while its exports seldom exceeded, and frequently did not reach, the sum of 80,000*l.* The balance was supplied by the sums, which the French government expended in paying the troops, building ships, raising fortifications, &c.; but the bills drawn upon the treasury of France on these accounts were not long very punctually paid. For a few years after the reduction of the colony, the British traders derived considerable assistance from the quantity of furs which had been previously collected, and from the sums of money which were regularly remitted for the payment of the large military force then supported in the country; yet the commerce of Canada was still rather in a declining than increasing state; and, in 1769, the quantity of produce exported amounted only, according to Heriot, to 163,105*l.*; but, according to Lambert, to 345,000*l.*, and was shipped in 70 vessels belonging to Great Britain and her colonies. During almost thirty years longer, its commerce continued in a state of great fluctuation, according to the varying degree of demand in Europe for its productions; but, in the year 1795, it was very considerably augmented by the scarcity of grain, which prevailed about that time in Great Britain and most of the European countries; and not less than 128 vessels (19,953 tonnage) arrived that year in the river of St Lawrence. At that period, also, the construction of vessels at Quebec was begun by a company of London, and very considerable profits were drawn from that branch of employment. In 1799, 1800, 1801, and 1802, an immense quantity of grain was exported; and, in the last of these years, it amounted to 100,000 bushels of wheat, 38,000 barrels of flour, and 32,000 casks of biscuit. The vessels employed in the transportation of these and other productions, were not fewer than 211, and the amount of tonnage nearly 36,000. As the crops in Canada, however, are extremely precarious, and the demand for its grain equally irregular, the surest statement of its commerce must be taken from an average of several years.

During the space of five years, ending in 1805, the average amount of exports from Canada to Great Britain and British settlements, according to Gray, was 767,705*l.* 17*s.* 3*d.* Sterling, and were conveyed in 193 vessels, equal to 33,996 tons. They consisted chiefly of wheat and other kinds of grain; beef, pork, and fish of various sorts; timber in the form of planks, staves, masts, oars, &c.; pot and pearl ashes; flax-seed, apples, and essence of spruce; butter and tallow, soap, beer, and castoreum; horses, cattle, and hides; stoves, manufactured at Trois Rivieres; vessels, built at Quebec; and furs and peltry, equal in value to more than one third of the whole.

The imports from Britain and British settlements, which pay duty, amounted to 204,105*l.* 17*s.* 6*d.* consisting principally of wines, spirits, sugar, molasses, salt, coffee, tobacco, cards; while those which pay no duty are calculated to have nearly equalled the difference between the above sum and the value of the exports, namely, 563,600*l.* consisting chiefly of cloths, linens, muslins, silks, furniture, tools, hardware, crockery, coals.

In consequence of the late improvements of the country, and the embargo on the American trade, the commerce of Canada has recently increased in a very astonishing degree. The unusual and growing demand for its productions, especially since the year 1808, has greatly increased the price of every article; and hence a considerable portion of the exports, such as timber, staves, pot and pearl ashes, and provisions of every description, have, in spite of the embargo-law, found their way across the boundary line of the United States into Canada, and been shipped for Europe and the West Indies with great advantage to the Canadian merchants. In 1806, the tonnage of the shipping employed in the trade of the colony amounted to 33,996; in 1807, to 42,293; in 1808, to 70,275; in 1810, to 143,893; and in 1811, to 223,762. The following tables, from Lambert, will afford a clearer view of the progressive and amazing increase of this commerce since the year 1754.

1754

No. of vessels.	Imports and exports.	Articles.	Separate amount.			General amount.		
			L.	*s.*	*d.*	*L.*	*s.*	*d.*
53	Imports	Merchandise..........	157,646	5	0			
		Wine, rum, brandy, &c.....	59,123	7	6			
						216,769	12	6
52	Exports	Furs and sundries..	64,570	2	6			
		Oil, ginseng, capillaire, timber, &c...........	7,083	6	0			
		Fish, oil, iron, vegetables, &c...........	3,906	19	2			
						75,560	7	8
		Balance against the colony,				*L.*141,209	4	10

1769

No. of vessels.	Imports and exports.	Articles.	Separate amount.			General amount.		
			L.	*s.*	*d.*	*L.*	*s.*	*d.*
34	Exports	Furs and sundries..	345,000	0	0			
		Oil, fish, &c. from Labrador	10,000	0	0			
						355,000	0	0
	Imports	Manufactured goods and W. India produce	-		-	273,400	0	0
		Balance in favour of the colony				*L.*81,600	0	0

1786

No. of vessels.	Imports and exports.	Articles.	Separate amount.			General amount.		
			L.	*s.*	*d.*	*L.*	*s.*	*d*
93	Exports	Furs and sundries..	445,116	0	0			
		Fish, lumber, and oils, from Labrador & Gaspé	45,000	0	0			
						490,116	0	0
	Imports	Manufactured goods and W. India produce	-		-	343,263	0	0
		Balance in favour of the colony				*L.*146,853	0	0

1797

No. of vessels.	Imports and exports.	Articles.	Separate amount.			General amount.		
			L.	*s.*	*d.*	*L.*	*s.*	*d.*
105	Exports	Furs and sundries..	295,063	15	0			
		Wheat, biscuit, and flour..	45,445	14	0			
		Oak, pine timber, planks & staves......	32,144	6	0			
		Pot and pearl ashes.......	29,866	0	0			
		Fish, lumber, oil, &c. from Labrador & Gaspé	88,900	0	0			
						491,419	15	0
	Imports	Manufactured goods and W. India produce	-		-	338,214	0	0
		Balance in favour of the colony				*L.*53,205	15	0

1807

No. of vessels.	Imports and exports	Articles.	Separate amount. L.	s.	d.	General amount. L.	s.	d.
270	Exports	Furs and other colonial produce	240,000	0	0			
		Wheat, biscuit, and flour	149,558	18	8			
		Oak, pine timber, planks & staves	134,344	10	0			
		Pot and pearl ashes	104,329	15	7			
		Fish, oil, &c. from Labrador &c.	115,555	11	1			
		Furs and sundries	70,112	0	0	813,900	15	4
	Imports	Manufactured goods,&c.	200,000	0	0			
		W. India produce	106,670	14	0			
		Merchandise	29,200	17	9			
		Oak, pine timber, &c.	39,000	0	0			
		Pot and pearl ashes	29,099	2	0			
		Tea, tobacco,&c.	63,324	0	0	467,294	13	9
		Balance in favour of the colony				L.346,606	1	7

1808.

No. of vessels.	Imports and exports.	Articles.	Separate amount. L.	s.	d.	General amount. L.	s.	d.
334	Exports	Furs and other colonial produce	350,000	0	0			
		Wheat, biscuit, & flour	171,200	0	0			
		Oak, pine timber, staves, masts,&c.	157,360	0	0			
		Pot and pearl ashes	290,000	0	0			
		Newships 3750 tons, L. 10 per ton	37,500	0	0			
		Fish, lumber, oil, &c.	120,000	0	0			
		Sundries, about	30,000	0	0	1,156,060	0	0
	Imports	Manufactured goods	200,000	0	0			
		W. India produce	130,000	0	0			
		Merchandise, tea, &c.	100,000	0	0			
		Oak, pine timber, &c.	70,000	0	0			
		Pot and pearl ashes	110,000	0	0	610,000	0	0
		Balance in favour of the colony				L. 546,060	0	0

A more complete view of the principal articles, which compose this growing and valuable commerce, may be afforded by the following lists of Exports and Imports for the years 1810 and 1811, which we have received from the most authentic sources, and which furnish more recent information on the subject, than can be found in the latest publications on Canada.

EXPORTS FOR 1810.

Cleared.
661 Vessels, 143,893 Tons.
6578 Men.

170,860	Bushels of wheat.	
12,519	Barrels of flour.	
16,467	Quintals of biscuit.	
18,928	Bushels of pease.	
866	Bushels of oats.	
16	Bushels of barley.	
1,600	Bushels of malt.	
98	Bushels of Indian corn.	
8,584	Bushels of flax seed.	
1,600	Minots of salt.	
2,977	Barrels	of Beef.
2	Half, do.	
4	Tierces	of pork.
4,628	Barrels	
3	Barrels	of tongues.
3	Half, do.	
64	Kegs	
6	Barrels	rounds of beef.
10	Half, do.	
69	Kits	
29	Puncheons	of hams.
1	Tierce	

422	Timets Firkins	of butter.
42	Barrels	hogslard.
107	Kegs and firkins	
1,070	Boxes of soap.	
1,181	Do. of candles.	
269	Tierces	pickled fish.
580	Barrels	
300	Quintals dry cod fish.	
14	Barrels of seal and cod oil.	
33,798	Pieces of oak timber.	
69,271	Do. of pine do.	
137	Do. maple, walnut, &c.	
312,423	Do. pine plank and boards.	
3,887,306	Do. oak staves and heading.	
47,515	Do. stave ends.	
13,623	Handspikes.	
15,150	Pieces of oars.	
6,977	Masts.	
678	Bowsprits.	
3,354	Spars for yards, &c.	
167,389	Pieces of lathwood.	
2,000	Feet scantling.	
130,516	Hoops, 12 feet long.	
80,000	Shingles.	
55	Buts	packs.
5,497	Puncheons	
1,301	Hogsheads	
771	Quarter casks	
228	Tierce	
29,407	Casks, containing 106,584 2 1 pot and pearl ashes.	
44	Hogsheads of beer.	
17	Puncheons of bottled do.	
26	Packets of hops.	
30	Bales cotton wool.	
71	Hogsheads	essence of spruce.
62	Casks	
4	Kegs	
10	Boxes	
6	Casks Canada balsam.	
44	Bales, 7375 hogsheads of capillaire	
8	Horses.	
5	Barrels of apples.	
87	Do. of onions.	
195	Cast metal stoves.	

Furs and Skins.

98,523	Beaver skins.
554	Martin
2,645	Otters.
169	Mink.
2,536	Fisher.
1	Fox.
10,751	Bear and cub.
82,551	Deer.
59,521	Raccoon.
2,428	Cased and open cat
534	Elks.
19	Wolves.
517	Wolvereens.
9,971	Musquash.
327	Lynx skins.
2,684	Squirrels and hares
59	Seals.
1,833	Swans.
265½	Pounds Castoreum.
1	Pum. ox hides.
24	Calf skins.
3	Barrels feathers.
10	Ginseng.
12	Kegs snuff.

Imports of Dutiable Goods.

8	Buts	Madeira wine, containing 20,087 gallons.	
149	Pipes		
37	Hogsheads		
57	Quarter casks		
4	Chests		
232	Pipes	Port	296,350 gallons.
2	Hhds.		
137	Cases casks bottled		
412	Pipes	Teneriffe	
187	Hhds.		
74	Butts	Spanish	
1,426	Pipes		
332	Hhds.		
10	Casks	French prize	
6	Cases		
15	Hhds.	Malaga	
20	Qr. casks		
6,976	Puncheons	rum, containing 726,534 gallons.	
188	Hogsheads		
496	Casks molasses, 46,874 gallons.		
226	Pieces brandy	29,944 gallons.	
25	Do. Geneva		
290	Casks refined sugar, 268,449 lbs.		
928	Hogsheads	Muscavado sugar, 1,478,892 lbs.	
186	Tierces		
738	Barrels		
1	Hogshead leaf tobacco, 982 lbs		
2	Casks manufactured, 366 do.		
6	Pounds snuff.		
14	Tierces	of coffee, 26,258 lbs	
83	Barrels		
11	Bags		
14,544	Packs playing cards.		
81,621	Minots of salt.		
1,685	Hyson tea	lbs.	
8,323	Green and black		
710	Bohea		

Exports in 1811.

532 vessels cleared, of which 37 have been built this year. 116,687 tons, 5,553 men.

34,741	Pieces oak timber.
58,575	pine do.
2,330,842	staves and heading
62,285	stave ends.
396,674	boards and planks
6,053	handspikes.
21,565	oars.
4,525	masts.
562	bowsprits
3,325	spars.
192,170	hoops.
222,236	lathwood.
70	battens.
1,328	capstan bars.
3,500	treenails.
40	staunchcons.

141	Pieces walnut and maple.	
82	. . boat-hook handles.	
2,168	. . window stiles.	
1,154	. . deal ends.	
6,535	Pipe	packs.
151	Puncheon	
1,188	Hogsheads	
1,320	Quarter casks	
63	Tierce	
22	Barrel	
848	Bushels wheat.	
5	. . . cublings.	
4,487	. . . pease.	
368	. . . Indian corn.	
1,016	. . . oats.	
7,688	. . . flaxseed.	
19,340	Barrels flour.	
13,063	Cwt. biscuit.	
2	Barrels	crackers.
22	Half, do.	
4	Kegs	
2	Kegs barley.	
3	Kegs rice.	
68	Tierces	pork.
4,618	Bbls.	
31	Tierces	beef.
3,582	Bbls.	
3	Bbls.	rounds beef, &c.
22	Half, do.	
13	Kegs	
12	Tubs	
42	Kits	
2	Puns.	pigs cheeks.
2	Hhds.	
1	Bbl.	
3	Kegs tripe.	
5	Casks	hogs lard.
59	Bbls.	
487	Kegs	
3	Barrels	tongues.
99	Kegs,	
9	Boxes	sausages.
57	Kegs	
26	Puncheons	hams, &c.
11	Bbls.	
1	Box	
2,858	Firkins, bbls., and kegs butter.	
744	Boxes soap.	
1,347	Boxes candles.	
3	Casks	cheese.
5	Boxes	
1	Keg	
7	Loose	
50	Horses.	
18	Sheep.	
6	Turkies.	
60	Casks, 50 jars oil.	
8	Bbls. tar, 5 bbls. turpentine.	
20	Bbls., 5 kegs tallow.	
2	Tierces, 3 bbls., 100 hides loose.	
21	Sides leather.	
317	Tierces	salmon.
375	Bbls.	
12	Boxes	
1,926	Barrels	herrings.
6	Half do.	
21	Barrels	smoked do.
182	Boxes	
5	Barrels mackarel.	
115	Do. shad.	
339	Bbls. pickled fish.	
1	Bbl. trout.	
7	Puncheons	cod fish.
146	Hogsheads	
225	Casks	
2	Boxes	
155	Cwt. loose	
10	Barrels	cyder.
16	Boyes	
6	Puncheons	ale and beer.
33	Hogsheads	
14	Casks	
43	Bbls.	
24	Bales of Hops.	
99	Casks	essence of spruce.
17	Hogsheads	
22	Boxes	
10	Cases	
38	Kegs	
15	Casks	Canada balsam.
2	Kegs	
1	Cask	snuff.
5½	Bbls.	
13	Kegs	
300	Pounds	
3	Tierces	tobacco.
4	Hogsheads	
4	Casks	
3	Bbls.	
8	Bales cotton wool.	
2	Hogsheads flax.	
1	Bbl. bees wax.	
9	Bbls. feathers.	
6	Boxes mustard.	
1	Puncheon deer hams.	
105	Stoves.	
335	Bbls. apples.	
115	Do. onions.	
2	Puncheons	cranberries.
1	Hogshead	
2	Bbls.	
2	Kegs	
1½	Bushels	
22,734	Casks pot and pearl ashes, W. J. 77,497 0 4.	

Furs and Peltries.

80,123	Beaver skins.
77,218	Deer, do.
28,249	Raccoon, do.
4,176	Swan, do.
2,501	Fisher, do.
2,153	Otter, do.
1,887	Musquash, do.
400	Bear and cub, do.
273	Fox, do.
292	Elk, do.
98	Martin, do.
45	Seal, do.
21	Cat, do.
4	Weasel, do.

2	Parchment deer, do.	
2	Buffalo, do.	
1	Wolf, do.	
1	Mountain goat, do.	
1	Cask	146 lbs. Castoreum.
1	Case	
2	Kegs	

IMPORTS—*Dutiable Goods.*

495 vessels entered, 107,075 tons, and 5052 men.

4	Butts		Madeira wine 22,604 gallons.
172	Pipes		
55	Hhds.		
45	Qr. Casks		
2	Half, do.		
2	Casks	Bottled.	
7	Cases		
309	Pipes	Port wine	113,804 gallons.
30	Hhds.		
17	Cases bottled		
1	Pipe	Lisbon wine	
1	Hhd.		
315	Pipes	Teneriffe do.	
92	Hhds.		
30	Qr. casks.		
83	Pipes	Spanish do.	
24	Hhds.		
2	Qr. Casks		
25	Pipes Marcella do.		
6	Pipes	Malaga do.	
2	Qr. Casks		
39	Pipes Sicilian do.		
42	Do.		
35	Casks	French do.	
5	Hhds.		
140	Cases		
7,641	Puncheons.		
216	Hhds.	Rum—810,971 gallons.	
7	Bbls.		
227	Boxes noyau.		
10	Puncheons British brandy, 1089 gallons.		
10	Pieces brandy	1821 gallons.	
5	Do. Geneva		
615	Puncheons	Molasses—59,346 gallons.	
57	Hhds.		
342	Hhds. refined sugar—278,948 lbs.		
2,178	Hhds.	Muscavada and clayed sugar —3,573,580 lbs.	
461	Tierces		
3,371	Barrels		
29	Boxes		
923	Casks	Coffee—393,421 lbs.	
909	Bags		
60	Casks leaf tobacco—60,926 lbs.		
1	Do. manufactured—370 lbs.		
22	Lbs. snuff.		
15,972	Packs playing cards.		
100,755	Minots salt.		
11	Chests hyson	Teas.	
19	Do. black		
2	Do. Bohea		
50	Bags Pimento.		
10	Bbis	Cocoa.	
40	Bags.		

Besides the trade, which Canada maintains with Britain and her dependencies, a very considerable traffic is carried on with the American states. The legal channel of this trade is by St John's, on the river of Champlain, where there is a custom-house for its regulation; and the imports by this course, in 1806, amounted to 75,546*l.* 11*s.* 6*d.* consisting principally of teas, chocolate, coffee, tobacco, spirits, butter, fish, pork; leather, shoes, and boots; nankeens, stockings, mahogany, pot-ash, hogsheads, and hops: but, by other channels, cottons, silks, cambrics, and groceries, are annually smuggled into the country, to the amount of 100,000*l.* The exports, by this communication, are more correctly known: and amounted, during the same year, to 66,586*l.* 8*s.* 2*d.* consisting chiefly of hides, salt, fish, and especially of furs.

Ever since the year 1796, the Americans have been permitted, under authority of the 3d article of Mr Jay's treaty, to import into Canada, East India goods, groceries, and several other commodities, duty free; and as, by a variety of advantages attending a neutral flag, they are able to transport East India articles into America, and thence into Canada, much cheaper than can be done by British merchants, they have gained almost exclusive possession of this branch of trade in the colony. The money sent out of Canada to the United States in payment of their goods, besides creating a greater scarcity of specie, which lowers the rate of exchange, occasions an increase of price upon every article of Canada produce, and thus enables the American to undersell the Canadian merchant in Europe, as he does the European in Canada.* Besides restricting the American trader from such privileges, there are many obvious reasons for securing to the British North American colonies the exclusive right of supplying the West India islands with lumber, fish, bread, flour, &c. for which they at present depend so entirely upon the United States.

The provinces of Canada, especially if encouraged by bounties from the British government, as the Americans are by theirs, could soon be enabled to furnish the West Indies with sufficient quantities of all these articles, so as to preclude them completely from suffering any great inconvenience from American embargoes and non-intercourse acts.

The articles of Canadian traffic comprehend almost every necessary of life; but the principal productions which it supplies for commercial purposes, are grain, timber, fish, and furs.

The only grain that is exported, is wheat, which is of an excellent quality, and yields a greater proportion of flour, than that which is brought from the Baltic. That of Upper Canada is superior to what is produced in the Lower province, and is usually exported in the form of flour; as it is thus more easily conveyed by the navigation on the lakes and rivers, more secure against damage in the voyage, and more beneficial to the country by the profits and wages of labour arising from its preparation. It is even frequently converted into biscuit, which is both of a good quality, and cheaper than what is procured from Britain; and which is sent to supply the shipping at Newfoundland and Halifax. The timber of Canada is also a principal article of exportation, and can be furnished for every purpose of the dock-yard, house carpenter, and cabinet-maker. Its oak is next to that of Great Britain in point of quality; its pines can furnish masts 120 feet in length; its staves are peculiarly excellent, and daily rising in demand; its forests, in short, could easily render the mother country independent of every other foreign supply of timber. This branch of trade has greatly increased of late years. It is said, that, in 1810, not less than 600 vessels arrived in the St Lawrence for this single article, and regulations have been made by the British government, to favour the importation of Canadian timber to a still greater extent.

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* We understand, however, that orders have recently been issued for prohibiting a traffic so injurious to the British merchant, and which the threatening attitude of the United States at the present moment (Feb. 26, 1812) would render it in the highest degree impolitic to permit.

The fisheries of Canada have not been prosecuted to the extent of which they are capable, and have received very little encouragement from government. There is a seal and porpoise fishing on the St Lawrence, which produces a considerable quantity of skins and oil; and on the Labrador coast an establishment has been formed, which sends chiefly to the West Indies large cargoes of cod, mackarel, shad, herring, salmon, and a fish about the size of salmon, called *bass*.

But the fur-trade of Canada may be considered as the chief peculiarity in its commerce; and though not so valuable a branch of traffic to the colony as grain, or to the mother country as timber, is at least next to either of these in importance, yielding a duty of 20,000*l.* annually; and is most of all entitled, from its nature, to a more particular description in this place. In this trade, the French settlers engaged with great eagerness, at the first establishment of the colony; and, as the Indians were not then acquainted with the value of the articles, large quantities of the richest furs were procured, in exchange for the most trifling wares. The accumulation of skins in the magazines soon became so immense, and the demand so inadequate to carry off the supply, that the merchants were unwilling to purchase more, and the abundance of the article nearly ruined the trade in Canada. The adventurers, who explored the Indian territories in quest of furs, and who were styled *Coureurs de Bois*, naturally sought a market among the English settlers in the neighbouring colonies, and many of them fixed their residence in the country of New-York. The attempts, which were made by the governors of New France to prevent such desertions, and to recal those fugitives, were long attended with little success. Many of them became attached to a wandering life, and took up their abode among the savages, from whom they could be distinguished only by their superior licentiousness of manners. As the conduct and example of such characters occasioned the greatest obstacles to the exertions of the Catholic missionaries, an order was at length procured, that no one should be permitted to traverse the country for the purpose of trafficking with the Indians, without a license from government. These permissions were at first granted only to persons of known respectability, to officers of the army, or to their widows. Such, however, as did not choose to make use of the licences personally, were allowed to sell them to the merchants, who again employed the Coureurs de Bois in quality of agents, and these again soon furnished occasion for renewed complaints from the missionaries. Military forts or settlements were at length established at the confluence of the rivers with the larger lakes, which served at once to protect the trade, and to check the improper conduct of the more profligate adventurers; while, on the other hand, a number of respectable men, who had retired from the army, prosecuted the trade in person, under their respective licences; and, with the assistance of the missionaries, extended their excursions as far as 53 north latitude, and 102 west longitude.

For some time after the conquest, the fur trade was in a great measure suspended, partly because the conquerors were not sufficiently acquainted with the country, and with the language of the agents; and partly, because they were exposed to great personal hazard among the Indians, whom the French had inspired with the utmost hatred against the British. But these obstacles were gradually surmounted; and a very keen competition was excited among the traders. This spirit of rivalry, however, gave rise to endless contests and innumerable irregularities; and, with the exception of a very few individuals, the agents in general conducted themselves in so imprudent and disorderly a manner, as to draw upon themselves the determined hostility of the Indians. A resolution was actually adopted by the principal tribes to free themselves from such troublesome neighbours, by a general massacre of the traders; and they were prevented from putting their plan into execution only by one of the most dreadful calamities, that could have befallen a people; by the fatal ravages of the small-pox, which raged among them with the fury of a pestilence, spread its baneful influence with the rapidity of a conflagration, swept away whole tribes at once, and rendered immense tracts of country entirely desolate.

The country being thus depopulated, and the traders also reduced in number, the merchants in Canada formed a junction of interests in the year 1784, under the denomination of the North West Company; the traders forgot their animosities, and engaged with great spirit in the service of the new establishment; but it was not till the year 1799, when the demand for furs, as an article of dress, became more general, that the speculation was productive of much profit. The number of persons who hold shares in this company amounts to more than forty; and the clerks, voyageurs, and Indians employed in their service are upwards of three thousand. The business in the north-west territory is conducted by young men in the service of the company, who are chiefly composed of adventurous young Scottish Highlanders, and who have under them a body of Canadians, hunters, and canoemen. These repair to the country of the Indians, and establish trading posts among them, frequently at so great a distance, that it requires more than one summer to send them the goods, with which they are to traffic, and to procure the furs, which they have collected. In these distant regions they remain for several years, subject to numberless privations, and subsisting in a great measure by hunting; while those who manage the concerns of the company, and who have the principal shares in the undertaking, generally reside at Montreal. To these posts more than fifty canoes are sent annually, loaded with merchandise, and navigated by nearly 1000 people. The persons, employed for this purpose, styled *voyageurs*, are a very peculiar set of mortals, of a most robust nature and thoughtless character, and said in these respects to bear a striking resemblance to British seamen. Though they know, that, for the space of 2000 miles, their exertions must be unremitting, and their living miserably poor, yet they pursue their tedious and toilsome occupation with the utmost cheerfulness. Sometimes they save their wages, and, returning to their native parishes, spend the remainder of their days in the labours of agriculture; but they generally acquire habits of dissipation, squander their gains as speedily as possible, and are thus compelled to set out upon a new excursion.

In this trade, the capital, which is employed in goods alone, is said to exceed 100,000*l*. The goods are made up in packages, about 80lbs. each, for the purpose of being more easily removed and carried, when the loaded canoe is not able to pass along the stream. The canoes in which these goods are conveyed to such a distance, are exceedingly light and frail, but constructed with wonderful ingenuity. The frame is formed of thin slips of wood, covered with the bark of the birch tree, sewed together with the filaments of a particular root, and rendered water-tight by a species of gum, which becomes very hard, and adheres very firmly. They are generally about thirty feet in length, and six in breadth, tapering to a point at each end, and rounded in the bottom, without any keel. Each of these carries from four to five tons; and they are rowed along with paddles, instead of oars. When they meet with falls and rapids in their progress, the canoe must be unloaded, and carried, with its cargo, to the next navigable water. On these occasions, six men will carry one of the largest, and one man will bear four or five packages, about 80lbs each, over a *portage* of several miles.

Another fur company has lately been established, under the title of the South West Company, because they collect their furs chiefly from the south-west parts of America; and they are sometimes called also the Michillimackinac Company, because they have an establishment in that quarter. The capital employed in these speculations is generally about three years without procuring any returns; and would thus require almost triple the profits of any other trade. It is rather a remarkable and apparently incredible fact, that manufactured *furs* can be procured at a cheaper rate, and of a superior quality, in England than in Canada. In the latter country, these articles are very large and heavy; and a Canadian furrier puts into one muff a greater quantity of materials, than would be employed in London for three.

The manufactures of Canada, though daily increasing, are still very limited in their number and extent. Previous to its conquest by the British, and during several years after that event, the inhabitants easily provided, by their own industry, the few necessary articles, which their simple mode of living required; and every family then prepared for their own use, druggets, coarse linens, stockings, worsted caps, hats, bonnets of straw, &c. As their wants increased, they imported, chiefly from Great Britain and the United States, a great variety of articles for domestic purposes; but the greater part of those they have of late years begun to manufacture for themselves. Among their principal manufactures for the purpose of exportation may be mentioned the conversion of their wheat into *flour and biscuit*, which gives employment to a great number of hands; the *building of ships*, which is peculiarly useful in the country, as it is almost the only occupation, which can be followed, during the six months of winter; *bar-iron*, *stoves*, *cooking utensils*, for which there are two considerable iron forges in the province, one near Three Rivers, which was established by the French king, and another near St Anns, on the road from Quebec to Montreal, with others of less importance. *Potash*, of which the country could easily supply any quantity, though the inhabitants prepare little more than what is necessary for the manufacture of the soap, which they make in every family *Soap*, *candles*, and *snuff*, for the manufacture of which last article Canada has long been celebrated, and the use of which is remarkably common among the females of the country, of all ranks and ages; while the men, and even boys, on the other hand, are seldom without a tobacco pipe in their mouths, from the moment that they awaken in the morning till they return to bed at night. Among the articles, which they prepare for their own consumption, may be particularly mentioned, *hats*, of which, however, the *bodies*, as they are called, are still chiefly imported from England, where they can be procured at a cheaper rate, than they can be made in Canada; *leather*, for the preparation of which several considerable tan-works are lately established; and *sugar* from the maple tree, of which so much is made as nearly equals two-thirds of the whole consumption of that article in the country, and which might be prepared for trade and exportation, if the West India sugars were not so abundant and cheap in the province. In March and April, when the sap begins to rise, those, who wish to make sugar, provide themselves with the proper apparatus; make an excursion into the woods, where maple trees abound; collect the sap from incisions made in the trunk; erect their boilers on the spot, and return in a few days with sugar ready for use, which, when properly purified, is of an excellent quality. There is a large distillery established at Quebec, and several breweries in the lower province, which export considerable quantities of ale.

In addition to the principal products of agriculture, which have been already particularly noticed, in a preceding paragraph, it may here be mentioned, that various other kinds of grain and pulse are raised in Canada, especially rye and beans; the last of which are of a smaller size than the European, and are much used by the Indians, who eat them when boiled, as an accompaniment to bear's grease and lard. Gourds, and water melons, are cultivated as field crops; and are used, as bread, by many of the native tribes. The orchards and gardens, especially in the neighbourhood of Montreal, abound in a great variety of fruits and vegetables of the finest quality. The apples are particularly good, and yield an excellent cider. Peaches, plums, gooseberries, raspberries, and currants, are found in the greatest perfection and abundance; and, with the protection of glass, grapes may be raised for the table equal to any in Portugal. The natural and indigenous productions of the country are remarkably numerous; and many of them are of considerable value.

The forests abound with an immense variety of trees, of the different kinds of which even the names are not yet known. Of *oak* there are various sorts: the black, white, red, yellow, grey, according to the colour of the wood, when cut by the saw; the *swamp oak*, which grows only in a moist gravelly soil, has a smaller leaf and smoother bark, than the other kinds, and is so remarkably tough, as to be frequently used in place of whale bone; and the *chesnut oak*, the leaf of which resembles that of the chesnut, and which is neither so tough as the last mentioned, nor so strong as the other sorts, but is peculiarly suited for being split, and for enduring a long time, in pallisades and fences: all the oaks in this country grow so straight, that, in ship building, the knee-timbers are generally made of the roots of pine.—Of *pines*, there are the white and red in great abundance, the former of which, chiefly, grows to an amazing height, and yields excellent turpentine.—The *firs* are perhaps the most numerous class, one of which called the white prickly fir, yields a kind of turpentine called Canadian balsam, which holds a place in the materia medica of most countries.—The *cedars* are distinguished into white and red, the former of which has its fragrance in the leaf instead of the wood, but is a different tree from the white cedar of the United States, the *cupressus disticha.*—Of *maples*, the harder kind, which grows on hilly grounds, yields a richer juice, but in smaller quantity than the soft, and its wood, which is finely veined and clouded, is peculiarly valuable for making tables, gun-stocks, &c.—Of *ash*, the most remarkable sort is the *yellow*, found only in the south-west districts, and growing to an amazing height; the outer bark of which is eight inches thick, indented with furrows, six inches deep, while the inner is of a fine yellow colour, which leaves a lasting stain upon the fingers, and is supposed useful in dyeing. Besides *beech*, *birch*, *elm*, *poplar*, and other kinds of timber, resembling the European, there are the *hemlock tree*, an evergreen of very large growth, with leaves like the yew, but is of no use whatever;[*] the *bass*, or *white wood*, remarkably white and soft, light as cork, and much used in making bowls, trenchers, &c.; *wickopic*, or *suckwick*, a species of wood, the bark of which when pounded, and moistened with a little water, becomes a kind of oily and adhesive glue, with which the Indians cover the seams of their canoes. In addition to the *walnut*, *chesnut*, *hazle*, *hickory*, &c. the forests of Canada produce the *butter*, or *oil-nut* tree, which grows in rich meadow grounds, bears a large and well flavoured nut, capable of yielding a very pure oil.

In a natural state are found the *crab apple tree*,[†] bearing a fruit of better size and flavour than that of Europe; the *plum-tree*, green, and purple, both greatly relished by the natives; the *cherry tree*, black, red, and sandy-coloured, but the first, only, bears a fruit pleasant to the taste; the *mulberry*, red and white, resembling those of France and Italy; *sweet gum tree*, yielding a kind of balsam, which the Indians highly value as a salve and febrifuge; *vines*, which are very common, and some of which bear excellent grapes; besides *gooseberries*, *currants*, *raspberries*, *strawberries*, *juniperberries*, *cranberries*, *bearberries*, &c. in the utmost abundance.

Among the more remarkable shrubs, may be noticed *sassafras* (found only in Upper Canada), which grows indeed to the size of an apple-tree, and the berry of which is sometimes used as a spice; a kind of *willow*, the roots of which are of a fine scarlet colour, and are used by the Indians to tinge the ornamental parts of their dress; *moose wood*, the bark of which makes nearly as good cordage as hemp;[‡] and the *myrtle wax* tree, the nut of which yields an excellent wax of a green colour.[§]

The most valuable roots are, *spikenard*, *sarsaparilla*, and particularly *ginseng;* which last was first discovered in the woods of Canada in the year 1718, and, being exported to Canton, was pronounced to be equal in quality to any that could be procured in Corea or Tartary. Its price immediately rose in Quebec from 1*s.* 6*d.* per lb. to 1*l.*: 0.: 10*d.* sterling; and the value of its export amounted, in 1752, to 20,000*l.* But the Canadian traders, too anxious to enrich themselves on a sudden, began to reap the plant too early, and to dry it hastily in ovens, instead of gradually evaporating its moisture in the shade; by which means they destroyed its quality, and completely ruined its sale among the Chinese, by whom chiefly it is used as a stomachic.

Besides the flowers usually found in the more northern countries of Europe, the woods of Canada are universally adorned by the fragrant blossoms of the Syrian *asclepias*; and, amidst a variety of curious and useful herbs, we can only notice the *rattlesnake plaintain*,[‖] the leaves of which are considered as the most effectual cure for the bite of the reptile from which it takes its name, and which is said to be most luxuriant in its growth during those months of the year, when the bite of that creature is most venomous. Canada abounds in natural grass; and cattle fatten easily upon the wild growth during summer. A particular species, very long and rank, called *l'herbe au lien*, grows upon some of the islands, and forms a most durable covering for stables, barns, &c. There is also a graminaceous vegetable, nearly allied to the rice, *zizania aquatica*, which grows abundantly in all the shallow streams, is found in situations that refuse all other culture, is a principal support of the wandering Indians, and is entitled to particular attention from the European settlers, as a plant evidently intended by nature to be the general bread-corn of North America.[¶]

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[*] The Hemlock is very useful for a variety of purposes; and the leaves help to support cattle and moose, during the winter. [MEASE.]

[†] The Crab apple (*Pyrus Coronaria*) is not eatable, unless when preserved in sugar; and is then excellent. [*Ibid.*]

[‡] Moose wood is a small tree about six feet high, the stem of which is about the size of a man's arm. The moose-deer are extravagantly fond of the bark, and choose a spot in which it abounds, for herding in during the winter. The bark strips off very easily at all seasons, and when plaited, is used for waggon and sleigh traces. It is also used by travellers in the woods, to wrap round their shoes and limbs, to defend them from briars and bushes, and to enable them to walk with more firmness. [MEASE.]

[§] The wax is produced by boiling the berries: The plant is Myrica Cerifera, and common to all North America. [*Ibid.*]

[‖] This plant is the *Hieracium Kalmii;* and must, of course, be most luxuriant when the bite of the snake is most venomous, because this happens in the summer.—In the winter, the rattle-snake becomes quite torpid, and the plant dies from the effects of cold. The Hieracium is only one of nearly fifty plants, equally celebrated for the cure of the effects of a snake's bite—all of which are probably of equal merit. [*Ibid.*]

[¶] It is very singular, that because Providence has kindly placed a mild farinaceous seed in an inhospitable barren country, for the support of the wretched wanderers of the forest, a conclusion should be drawn of so extensive a nature, as that the plant was "*evidently* intended by nature to be the general bread-corn of North America." The writer might be glad of such a substitute for other bread, while on an expedition to the North-West Coast, but he would rejoice, when an opportunity offered, of exchanging it for wheaten bread, Indian corn-bread, or even *oat-cake*. [*Ibid.*]

Among the domestic animals of Canada, which are much the same as those of Europe, there are scarcely any peculiarities worthy to be mentioned. The Canadian *horse* is a hardy, active animal. His best pace is a trot; and, in a light cariole, upon smooth, hard roads, a single horse has been known to draw two persons ninety miles in twelve hours. It is affirmed, that he will eat dried fish in the winter season; but he is most of all remarkable for the extraordinary operation, which he frequently undergoes, when travelling on the frozen lakes and rivers. In these excursions, it is not uncommon for the sledge and horses to sink suddenly in the weaker parts of the ice, when the traveller springs from his seat upon the ice, which is generally strong enough to support his weight, and instantly proceeds to save his cattle. As their struggles in the water would only tend to sink them the sooner, he pulls with all his strength a rope, with a running noose, which is previously fixed around the neck of each, in case of such accidents, till he succeeds in strangling the animals. As soon as this happens, they float upon one side, and are easily drawn out upon the ice. It is sometimes necessary to draw blood from them before they recover; but, in general, whenever the noose is loosened, respiration recommences in a few minutes, the creatures start to their feet, proceed with their usual vigour, and perhaps go through the same process two or three times in one day. This singular fact is solemnly avouched to be strictly true, both by Chattelux, vol. i. p. 408, and Gray, p. 277.* The native *dogs* of Canada are all of the same species, with erect ears, and a head very much resembling that of a wolf. They are very useful to the Indians in the chase; and the colonists frequently employ them in the draught. They are yoked to sledges in winter, proportioned to their size and strength; and in this way one of an ordinary size will frequently draw more than 200 lbs. weight, with his driver, in addition, standing behind the sledge. They are thus employed in a variety of domestic services, in dragging children in small carriages, in bringing water from the river, and particularly by the butchers in transporting meat to their customers in different parts of the towns.

Among the wild animals which frequent the immense forests of this country, the principal beasts of prey are, a small *tyger* or *panther*, though it is supposed by some to be altogether a different species of animal; *bears*, *wolves*, *foxes*, *dogs*, *cats of the mountain*, *pole-cat*, *carcajou*, *lynx*, *racoon*; but they are all inferior to those in the other quarters of the globe, both in size† and ferocity; and are scarcely daring enough to attack a man, unless when they are wounded. The grizzled bear is the only dangerous animal. Those which are chiefly pursued for the sake of their peltry and fur, are, the *buffalo*, *elk*, *moose deer*, or rein-deer,‡ *carribou*, *bear*, *fox*, *wolf*, *cat*, *beaver*, *otter*, *martin*, *mink*, *woolvereon*, *racoon*, *ermin*, *fisher*, *squirrel*, *hare*, *rabbit*, *musk-cat*; of which the beaver, otter, bear, fire-martin, cat, elk, and wolf, are by far the most valuable. But, for an account of these animals, our readers are referred to Pennant's *Arctic Zoology*, and to the articles MAMMALIA, &c.

Of the feathered tribe, may be mentioned, the *eagle*, *vulture*, and *owl*; the *night-hawk*, which is seen chiefly at twilight and before thunder-storms; the *fish-hawk*, which skims along the rivers and lakes, and is supposed to attract the fish to the surface by a peculiar oil which he emits, and one drop of which upon any bait is said to render it irresistible to every kind of fish; *cranes*, with bills 12 inches in length; *geese*, particularly the *outarde* or Canada goose; *wild ducks*, of more than twenty different kinds, of which the principal is the wood-duck, which perches upon trees, has a brilliant plumage, and flesh of superior flavour; *partridges*, brown, red, and black, which are all larger than the European, and which, in winter, perch upon such trees as yield them food; the *white* or *snow-bird*, a kind of ortolan, which is the principal bird of melody in Canada, and announces the return of spring; *teal* of excellent quality; *wood-pigeons* in immense numbers; *wood-peckers*, *humming-birds*, *black-birds*, *thrushes*, *larks*, *goldfinches*, *&c.* resembling those of other countries.

In the numberless lakes and rivers of Canada are various kinds of fish, especially *salmon*, *chub*, and *carp*, like those of England; *cat-fish*, the flesh of which is fat and luscious like that of the eel; *black bass*, *pickerells*, and *maskinongs*, particularly the *sturgeon*, of large size and delicate flavour.

Upper Canada abounds in *rattle-snakes*, from four to six feet in length; *water-snakes*, resembling the rattle-snake, but not venomous; long *black snakes*, about six or eight feet long, but altogether inoffensive; *green snakes*, exactly coloured like the grass, but also harmless; a variety of smaller serpents, *lizards*, and *land tortoises*.

Among the insects common in this country, may be mentioned, *bees*, which prepare their honey under ground; *silk-worms*, which produce much less silk than those of Europe; *fire-fly*, or *lightning-bug*, which has a very effulgent appearance at night, and two or three of which upon the hand will yield a light equal to that of a candle; *horned bug*, or *stag-beetle*, which fly about in the evening, and whose bite is very troublesome; *musquitoes*, which abound in the forests and river-banks in the more southern districts; *locusts*, which are said to visit the more central regions every six or seven years; and in many of the islands in the St Lawrence, myriads of *ticks*, larger than those of Europe, which spread themselves in summer over the surface of the ground, completely cover the herbage and plants, frequently prove fatal to the cattle which graze in these places, and are exceedingly troublesome to human beings, especially if they reach the head, where, without occasioning much pain, they gradually insinuate themselves beneath the skin, and are not easily dislodged.

Canada, before its discovery by Europeans, was inhabited by an immense variety of Indian tribes, whose general character and manners have been already described in this work, under the article AMERICA; but whose particular designations, history, and territories, it is impossible to delineate. The smaller tribes, if we may judge from the number of names, amount to several hundreds; but, as they are perpetually changing their place of residence—as many of them have been exterminated by war or disease—as each of them almost is mentioned by different writers under separate appellations—as the French traders were accustomed to distinguish them by various nicknames, partly with the view of preventing them from being known to other adventurers, and partly for the purpose of concealing their subject of conversation, when they spoke of the natives in their own presence—it has thus become altogether impracticable to trace their progress, or to arrange their nations with any degree of certainty. The following sketch, however, formed from a careful comparison of different authors, may be sufficient to point out the principal Indian nations, by which the immense regions of Canada are still occupied, or at least occasionally visited; and may also help to guide the reader amidst the perplexities, which he will experience in the perusal of North American histories and travels, from the confusion of Indian names.

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* This fact is well known to every one who has been in Canada. [MEASE.]

† This opinion has been long since refuted by Mr Jefferson, in his Notes on Virginia: and by others since. [*Ibid.*]

‡ The Moose is altogether a different animal from the rein-deer; and is accurately described in Pennant's Arctic Zoology. [*Ibid.*]

The Hurons, whose proper name is said to be the Tsonnontatex, who are called also Adirondacks, and who seem to be the same people with the Utawas, dwelt originally on the east confines of Lake Huron, but were driven from their country by the Iroquois. They fled towards that quarter, where the French afterwards built Quebec; and were the first who formed an alliance with the new settlers. They are more prudent, sober, artful, and able than most of the other natives; speak the same language and have much the same appearance and manners as their inveterate enemies the Iroquois, by whose ravages they have been almost completely exterminated.

The Iroquois, a name given by the French to what are generally called *the five nations*, composed of—the Mohawks, or Maquas, or Agniers,—the Senekas, or Tsonnonthuans,—the Onnondagues, or Onnontagues—the Oneidoes, or Onneyouths,—the Cayugas, or Goyogans.—These, however, are now properly *the six nations*, as they were joined by the Tuscororas, from the south, who dwell with the Oneidoes and Onnondagoes. These nations, united in long and firm alliance, claim all the country south of the river St Lawrence to the Ohio, near to the borders of Virginia; and extend 300 miles west from Lake Champlain, round Lakes Ontario and Erie. They are superior to the other tribes in stature and courage; but inferior to many of them in swiftness of foot and skill in war. They are more civilized and ingenious, than most of the other Canadian Indians, and more addicted to agricultural occupations, than to the chase. They have in general been friendly to the English; and much depends upon the continuance of their attachment.

The Algonquins, or Algonkins, appear to have originally possessed the whole tract of country along the north shore of the St Lawrence, from Tadoussac to lake Nippissing, and had no rivals in North America, as warriors and hunters; but having afforded refuge and assistance to the Hurons, a deadly war arose between them and the conquering Iroquois, who at length succeeded in driving them from their country. They seem then to have taken a westerly progress, and may be said to have peopled the country from the Atlantic, in a direct line along the St Lawrence, and the Uttawas, along the high lands which divide the waters that fall into lake Superior, from those that fall into Hudson's Bay, or to lake Winipic, along the Saskatchiwine and Elk rivers to the lake of the Hills. The great proportion of the Indian tribes which are scattered over the cultivated parts of Canada, are of this nation; and the others, especially those in the neighbourhood of the lakes and the St Lawrence, are chiefly branches of the Iroquois, and the wretched remains of the Hurons. But the main body of the Algonkin nation is found far to the north west, and they are considered as the same people with those called Knisteneaux, Christineaux, or Killistinoes. They reduced the natives as they passed along, with most of whom they are now in alliance; but they are daily losing their superiority by their fondness for spiritous liquors, which are rapidly diminishing their strength and numbers. They are of a middle stature, well-formed, swift footed, and chiefly employed in hunting. They are just in their dealings, and affable in their address. They possess an open and agreeable countenance, and a generous and hospitable disposition.

The Chepewyans or Chipawas, called also Sarsees, and rocky mountain Indians, are a numerous people, who consider as their territories all the land between 60° and 65° north latitude, and 100° and 110° longitude. Their progress is easterly; and, according to their own tradition, they came originally from Siberia; which is partly confirmed by the strong resemblance, which they are said to bear to the people now found on the nearest coast of Asia. Their country is very barren, and they are frequently obliged to subsist upon a kind of rock moss, which is the principal vegetable substance that their soil produces. They are submissive to the Knistineaux, but hostile to the Esquimaux, to whom they give no quarter, and never indeed make prisoners in any of their wars. They are sober, timorous, vagrant, selfish, considerate, querulous, and superstitious in the extreme; more attentive to the comfort than to the appearance of their dress; not active hunters, but dexterous in snaring deer and spearing fish; uniform in their temper; not at all addicted to spiritous liquors, and by far the most peaceable of the North American Indians.

The Naudowessies, or Nadowasis, called by the French the Sioux, who inhabit the western side of the Missisippi, and the lower part of the Missouri, are a powerful nation, and consist of a number of bands, who carry their excursions a great way to the north, and are the constant enemies of the Knistineaux, or Algonquins, in those regions. The Assiniboins, or Assinipoils, or Stone Indians, are of the Nadowasis nation; but they separated from the other tribes, and formed an alliance with the Knistineaux.

The principal languages spoken among the various tribes of North American Indian are the *Chepewyan*, which is copious, but difficult to be atttained; and which furnishes dialects to the various tribes from Churchill fort up the Mississippi; through Buffalo Lake to the Lake of the Hills; along the Peace river to the source of the Columba, and thence due west to the sea coast.—The *Nadowasis*, which is a kind of hissing rather than articulate speech, and is chiefly used on the western banks of the Mississippi,—the *Mohawk*, *Iroquois*, or *Huron*, which is said to excel in energy and pathos, and in these respects to bear a comparison with the Greek. But the most celebrated and prevailing of all the native languages, is what Long calls the *Chipeway*, Carver the *Chipeway* or *Algonquin*, and M‘Kenzie the *Algonquin* or *Knistineaux*; but which, as their several vocabularies shew, are only different names for one and the same tongue. This is said to surpass all the rest in smoothness, elegance, and copiousness; is spoken by all the other tribes in their councils, negotiations, and trading interviews, though they use a distinct dialect of their own in ordinary cases, and extends from the Gulf of St Lawrence over a space of 3000 miles.

These different Indian nations are divided into an immense number of tribes and bands, which are all distinguished by particular marks on their bodies, by their mode of pitching their tents, &c.; but they are scattered over a great extent of territory, and are daily decreasing in their numbers. About the year 1780, the small-pox was introduced among them by a war party, as has been conjectured, from the Mississoaic. This malignant disorder "destroyed, with its pestilential breath, whole families and tribes; and the horrid scene presented to those, who had the melancholy and afflicting opportunity of beholding it, a combination of the dead and the dying, and such, as to avoid the horrid fate of their friends around them, prepared to disappoint the plague of its prey by terminating their own existence."—"It was not uncommon for the father of a family, whom the infection had not reached, to call them around him; to represent the cruel sufferings and horrid fate of their relations, from the influence of some evil spirit, who was preparing to extirpate their race; and to incite them to baffle death, with all its horrors, by their own poinards. At the same time, if their hearts failed them in this necessary act, he was himself ready to perform the deed of mercy with his own hand, as the last act of his affection, and instantly to follow them to the common place of rest and refuge from human evil." (M'Kenzie's *Travels*, *Introd.* p. xv.) The prevalence of other European disorders, and the pernicious effects of spiritous liquors, are rapidly completing the destruction of the native tribes; and the traveller may pass through districts of of many hundred miles, without meeting one human inhabitant.

The Indians, who inhabit the settled parts of Canada, are greatly degenerated in many of the noble characteristics of the more savage tribes; and they are represented as dirty, diminutive, half-naked, excessively stupid in their appearance, and altogether most miserable-looking creatures. The progress of the missionaries among them, once extended as far as the excursions of the fur-traders; but there is, at the present day, scarcely a vestige of their pious labours to be found, beyond the cultivated parts; and even such of the natives as have been converted to christianity by the Canadian Catholics, though in many instances wonderfully reformed in their external conduct, are, in general, very little civilized; and still continue powerfully attached to a wandering state of life. One of the gentlest of all the tribes, known by the name of Mountaineers, dwells around lake Saguenay: they are the most decent and industrious in their manners, they make no use of offensive weapons, and even spiritous liquors do not excite them to violence; yet they cannot be persuaded regularly to cultivate the lands, or to continue in any laborious occupation. In another village, at the rapids of St Ann, about two miles above Montreal, are two Indian tribes, one of the Iroquois and another of the Algonquin nation, who have both been christianized, since the first occupation of the country by the French, who regularly attend divine service in a chapel of their own, who have been instructed by their pastors in reading and writing, and who possess more religious information than many among the lower Canadians; but who are still said to have made no farther advances to a state of civilization, and still to retain their old habits, customs, and languages. The women sow a few patches of ground with maize and vegetables during summer; but, in the winter season, they leave their habitations and instructors to follow the chase, after the manner of their forefathers; and the same is affirmed to be the condition of most of the Indian settlements within the more cultivated districts of Canada.

The more immediate and stationary population of Canada, when it came into the possession of the British in 1760, amounted, by General Murray's report, to 75,600 souls; but, at that period, the extensive country, now denominated Upper Canada, was not inhabited by any Europeans. At present, the lower province contains about 200,000 inhabitants; of whom the descendants of the old Canadians, who profess the Roman Catholic religion, and are allowed the use of the old French laws, constitute at least nine tenths. In Upper Canada the population amounts to nearly 100,000, who are chiefly British or Americans, speak the English language, and are governed entirely by the laws of England, both in civil and criminal cases. Thus the inhabitants of Lower Canada have nearly tripled within the last 50 years; while in the upper province, the increase has been still more rapid. Several years elapsed, after the conquest, before the latter was settled and cultivated; and so late as the year 1780, it was almost one continued forest. Much of its immense population, within 30 years, has been formed by emigrants from Great Britain and the United States, who generally preferred a settlement in the upper province, because the soil and climate are superior, the lands cheaper and easier procured, while the laws, languages, and habits, are all purely British.

Any peculiarities in the modes of life among the inhabitants of Canada are most observable during the season of winter, which in that country presents a view of nature perfectly new to the natives of Great Britain. In this season the appearance and dress of the Canadians are completely changed; and instead of the hat and red bonnet, nothing is to be seen but fur caps, fur cloaks, fur gloves, and worsted stockings, both over and under the boots. Unless protected in this manner, they could not venture, with impunity, into the severity of the frosty atmosphere; but even under such a load of clothing, they are able to walk with the greatest agility, and to take abundant exercise, without being fatigued. When travelling in the cold of winter, they are still more completely covered with a double cloak, muff, and tippet, all of fur; and when they intend to deviate from the ordinary track, and go into the woods, they make use of snow shoes, which are made of a kind of net-work, fixed upon a frame, above 2 feet in length, 18 inches broad, and shaped like a paper kite. This simple instrument of walking takes in so much surface of snow, that the feet sink but a few inches, and the progress is rendered inconceivably easy. On account of the depth of the snow, it would be impossible to travel with wheel carriages; and a kind of sledge, which passes over the surface without sinking deep, and which is called a *cariole*, is substituted in their place. The body of this conveyance is shaped like a phaeton, a vis-a-vis, a family coach, or a market cart, according to the fancy of the owner, and the particular use to which it is applied. It is fixed upon *runners* as they are called, which resemble in form the irons of skaits, rising up in front after a similar manner; and it is generally 9 or 12, though sometimes 18 inches above the snow. These vehicles are, for the most part, light open carriages, drawn by one horse; but, though the snow under their tracks soon becomes firm and smooth, yet, from the improper construction of the carioles in common use, it is so full of inequalities, called *cahots*, that their motion is described by travellers as greatly resembling the rowing of a boat against a head sea, and as requiring long custom to reconcile a stranger to bear it easily. The small rivers, ditches, and fences, are so filled with snow, as to be upon a level with the fields on every side; and the country people, when they first form their tracks, direct their carioles by the nearest course, or where the snow is most level, without regarding the summer roads. These winter tracks they mark out by fixing in the snow small fir trees at short and regular distances, which retaining their verdure till the spring, appear like walks crossing the country in various directions, and have a very curious and striking effect. They generally prefer the bed of a river for this purpose, as there is commonly less snow, and less inequality of surface in that direction; and the principal road between Quebec and Montreal is the frozen channel of the St Lawrence. The river is seldom frozen opposite to Quebec, where the current, being greatly increased by the narrowing of the channel, keeps the masses of floating ice in constant motion; but sometimes, perhaps once in the space of every ten years, when there happens to be a concurrence of favourable circumstances, such as a collection of floating ice, calm weather, neap tides, and severe frost, the St Lawrence is completely frozen at the place above mentioned; and, as the ice then serves the purpose of a bridge to the inhabitants, it is called by them a *pont*. Such a circumstance is viewed as a kind of jubilee, and is celebrated with every token of rejoicing. The solid surface of the river is then covered with booths for the entertainment and amusement of the vast multitudes, who crowd upon the ice, on their skaits and carioles. But the inhabitants of the Canadian metropolis have much more solid grounds, than merely a love of amusement, for the joyful welcome, which they give to the formation of a *pont;* as it greatly facilitates the conveyance of firewood, provisions, &c. to the town; and as these necessary articles never fail, upon the occurrence of such an event, to be brought in great abundance, and to be very much reduced in price. When the river is not frozen, these and other necessaries are chiefly conveyed in canoes, which are formed of one solid piece of wood, generally the trunk of a large tree, hollowed properly in the inside, and formed outwardly into the shape of a boat. The navigation of these vessels, however, at that season of the year, is exceedingly hazardous, and requires a dexterity of management and coolness of mind, which are very remarkably displayed by the Canadians. For the time of their excursion, they choose the period of high water, when the masses of ice are nearly stationary; provide themselves with ropes, boat hooks, and paddles; and launch the canoe into the water, when they perceive an opening amidst the moving sheets. When they encounter one of these in their progress, they instantly jump out upon it, pull the canoe after them, push it across the ice, launch it on the other side, and paddle along till they meet with a similar obstruction, which they surmount in the same manner, and so on till they cross the river.

The severity of winter in this country is attended with various advantages, especially to the inhabitants of the towns. As the lakes and rivers are then frozen, the conveyance of many articles is thus greatly facilitated; and as the people in the country have no other occupation, to which they can apply, they employ themselves in carrying to town all kinds of provisions. The markets are thus supplied from a great extent of country; fish, for instance, is brought from the United States from a distance of 420 miles: and every article of subsistence is both more plentiful and also much cheaper than during summer. By the aid of winter, also, all kinds of animal food are preserved for the use of the colony, without much trouble or expence. As soon as the frost has become sufficiently intense, the cattle, sheep, poultry, &c. before they have lost any of the flesh and fat, which they have acquired by summer feeding, are killed, and exposed for a short time to the frost, upon which they become as hard as ice, and, after being packed in casks with snow, will continue, without any other preparation, perfectly sound and good for the space of four or five months. When meat, in this state, is about to be used, it is thawed in cold water; and would be rendered putrid in an instant, by any warm application. In this way, considerable quantities of fresh fish, especially of what the Canadians call *petite morue*, and the English *tommy cod*, are preserved for the market. They are caught by the country people, during the stagnation of their usual work, by nets or lines, let down through openings made in the ice. Sometimes huts of boards, or even of ice, are constructed over these openings, with a stove within to keep the fishers warm; a strong light is then placed near the mouth of the opening, by which the fish are attracted to the surface, and are taken as fast as they can be pulled out of the water. They are quickly frozen by a few minutes exposure to the air; are thus sufficiently preserved without any salting or drying; and, upon being thawed in cold water, are found to be thoroughly fresh and wholesome. Fuel, however, is both a scarce and expensive article in Canada, and counterbalances the abundance and cheapness of provisions in the winter season. Firewood is generally provided during the summer, and is brought to Quebec and Montreal in immense rafts upon the river St Lawrence; in winter, it is frequently carried on sledges. In proportion as the grounds are cleared, the distance of carriage is increased, and the price, of consequence, augmented. No coal has yet been discovered in the country, though it is supposed to exist in the neighbourhood of Quebec; but it abounds in Cape Breton, from which it would be easy for Canada to be supplied. Indeed there is plenty of English coal at Quebec, even at a cheaper rate than in London, which is frequently brought out as ballast in British vessels; but is in no great demand in Canada, because the natives dislike its smell, and prefer wood for their stoves, as long as it can possibly be procured.

During the severity of a Canadian winter, especially when a sharp wind prevails, instances frequently occur of those parts of the body which are most exposed to the air being frost-bitten; when a mortification immediately ensues, unless a remedy be instantly applied, by rubbing the affected place with snow. The hazard arises chiefly from this circumstance, that the feelings of the sufferer do not acquaint him with his own calamity; and that the effect is known only by the appearance of the injured spot, which acquires a white colour, while the surrounding parts continue red. In the event of such a spot being perceived, humanity dispenses with ceremony; and no one hesitates to apply a handful of snow to the cheek or nose of a perfect stranger, whom the frost has attacked. Sentinels, and persons who travel during night, are most apt to suffer serious injuries from this occurrence.

To guard against the intensity of the wintry atmosphere, the Canadians keep their houses extremely warm by means of stoves, generally at the heat of 73 degrees; and when they go out of doors, they thus not only carry out much warmth along with them, but so cover themselves with clothing, as to restrain the escape of the heat, and prevent the influence of the cold from being soon felt.

In order to preserve the stones of the houses from the accumulation of moisture in their fissures, and from the injurious effects which would be produced by the expansion of the watery particles in time of frost, the walls are well plastered on the outside; and that the plaster may better withstand the severity of the weather, two pounds of Muscovado sugar are frequently mixed with each bushel of lime, which renders the casting much more durable.

When the snow begins to disappear, and the lakes and rivers to break up, the ice, which is floated down the St Lawrence, is carried up and down by the tide, till it accumulates in immense quantities, and frequently chokes up the channel from bank to bank for the space of twelve or fifteen miles. Many of the individual masses, which compose this collected heap, are 400 or 500 yards in diameter; and these, dashing against each other by the tide or stream, breaking up into a multitude of smaller pieces, shelving up in a thousand forms and directions, present a spectacle of extraordinary sublimity, and of perpetual variety.

A great proportion of the people, especially those in towns, are destitute of employment during the six months of winter; but their wages during summer are seldom less than four, five, or even six shillings a day. Hence they dress as well, and live as comfortably, as the lower classes in any other country: but their long idleness during the winter season seems to generate an indolent habit; and they do not perform so much work, even when they are employed, as those who are regularly engaged in labour throughout the whole year. In the country they sometimes employ themselves in cutting and carrying home firewood, or in any kind of work that may help to keep them warm, and occasionally in making a journey to the nearest towns for the purpose of selling their surplus provisions, or of purchasing some little comforts to themselves, such as snuff, tobacco, spirits, &c. In towns, the whole six months of winter may be said to be devoted to amusements, of which the most prevalent is dancing; and, besides the regular assemblies for this purpose, they have occasional country parties, which may be considered as a kind of *pic-nic* feasts. The company ride out in the forenoon in their carioles, to some proper place, at a little distance from town, every one carrying a dish ready dressed; and after having dined, danced, and supped, they return home at midnight amidst the wind and snow; or, should the storm be unusually boisterous, contentedly remain where they are, and continue the dance till day-light appears, to guide them through the drifting blast.

The descendants of the ancient Canadian colonists retain all the politeness, sprightliness, and easy manners of the old French, from whom they are sprung.

They are healthy and robust in early life, and, when urged by necessity, capable of enduring patiently the greatest fatigues; but they soon lose their strength, and begin to have an aged appearance. Every man in the country is his own tradesman, sufficiently intelligent in his own affairs, and not liable to be easily overreached. They are naturally lively and thoughtless; and hence, perhaps, rather chargeable with inconstancy and ingratitude. The landholders are described, as honest, hospitable, religious, inoffensive, modest and civil; but extremely indolent, and strongly attached to ancient prejudices. Contentment of mind and mildness of disposition are said to constitute the leading features of their character. The country people still retain much of their ancient simplicity, in point of domestic accommodation, and mode of living. The furniture of their habitations is generally of their own workmanship, and of consequence is seldom very ornamental. Their principal article of food consists of pease soup, with a small quantity of pork boiled in it, and a dish of thick sour milk. They sometimes indulge themselves with a little tea or coffee; but, in these cases, the frying pan is generally made to perform the office of a tea-kettle. The women and children seldom use any other drink, than milk and water, but the men are all passionately fond of rum; and few of them, when they go to market with their commodities, return home perfectly sober. Their address to strangers is more polite and unimbarrassed, than that of any peasantry in the world. "It adds greatly," says a recent and intelligent writer on this country, "to the comfort of travelling in Canada, that you are every where treated with the greatest politeness and attention."—"A Canadian landlady, the moment you stop, receives you at the door with a degree of politeness and urbanity, which is as unexpected, as it is pleasing; *Voulez vous bien, Monsieur, avoir la complaisance d'entrer; voila une chaise, Monsieur, asseyez vous s'il vous plait.* If they have got any thing you want, it is given at once with a good grace. If they have not, they tell you so in such a tone and manner, as to show that they are sorry for it. *Je n'èn ai point, Monsieur; j'en suis mortifie.*" "Indeed you need never be at a loss for a house to stop at. There is not a farmer, shopkeeper, nay, nor even *seigneur*, or country gentleman, who, on being civilly applied to for accommodation, will not give you the best bed in the house, and every accommodation in his power." Grey's *Letters from Canada*, p. 126.

The following character of the French settlers, contrasted with that of the British or American, and from a pen, which must be considered as sufficiently impartial, may prove interesting and even instructive to our readers. That the description may have its full effect, we shall adhere very closely to the words of its ingenious and lively author. "The American settler, of English or German descent, naturally cold and phlegmatic, sedately forms a plan of managing a farm. He turns his mind, not ardently, but without ceasing, to every thing conducive to its formation or improvement. If, as some travellers have laid to his charge, he becomes idle, it is not till he has obtained the object of his pursuit, what he considers as a competency. The Frenchman, on the contrary, with his troublesome and restless activity, is led by enthusiasm, or some sudden fit, to undertake a project, of which he has calculated neither the expence nor the difficulties. More ingenious, perhaps, he rallies the slowness of his German or English rival, which he compares to that of an ox; but the German or the Englishman will answer with his cool good sense, that the patience of the ox is better adapted to the plough, than the fire of the mettlesome racer. And in fact it often happens, that the Frenchman, after having undone, corrected, and altered what he had begun, and harassed his mind with desires and fears, is at length disgusted, and relinquishes the whole. The American settler, slow and silent, does not rise very early; but when he has once risen, he spends the whole of the day in an uninterrupted series of useful labours. At breakfast, he coldly gives orders to his wife, who receives them with coldness and timidity, and obeys them without contradiction. If the weather be fair, he goes out, ploughs, fells trees, makes fences, or the like: if it be wet, he takes an inventory of the contents of his house, barn, and stables; repairs the doors, windows, or locks; drives nails, makes chairs or tables; and is constantly employed in rendering his habitation secure, convenient, and neat. With these dispositions, sufficient to himself, he will sell his farm if an opportunity offer, and retire into the woods, thirty or forty miles, to form a new settlement. There he will spend years in felling trees, making for himself first a hut, then a stable, then a barn; clearing the ground and sowing it, &c. His wife, patient and serious as himself, will second his endeavours on her part, and they will remain sometimes six months without seeing the face of a stranger. But, at the expiration of four or five years, they will have acquired an estate, that ensures a subsistence to their family. The French settler, on the contrary, rises early in the morning, if it be only to talk of it. He consults his wife on what he shall do, and listens to her advice. It would be a miracle if they were always of the same opinion; the wife argues, opposes, disputes; the husband insists upon or yields the point, is irritated, or disheartened. Sometimes his house is irksome to him, and he takes his gun, goes a shooting or a journey, or to chat with his neighbours. At other times, he stays at home, and spends the time in talking with good humour, or in quarrelling and scolding."—" This alone is one of the most distinguishing and characteristic features of the two nations; accordingly, the more I reflected on the subject, the more I am persuaded that the domestic silence of the Americans is one of the most radical causes of their industry, activity, and success in agriculture, commerce, and the arts; and the same applies to the English, Dutch, and other people of the north, from whom they are descended. In silence they concentrate their ideas, and have leisure to combine them, and make accurate calculations of their expences and returns. They acquire more clearness in their thoughts, and consequently in their expressions. Hence there is more decision in their conduct, both public and private, and it is more to the point. On the contrary, the Frenchman, with his perpetual domestic chattering, evaporates his ideas, submits them to contradiction, excites around him the tattling of women, backbiting, and quarrels with his neighbours; and finds at length he has squandered away his time, without any benefit to himself or his family." " This moral and physical dissipation must have a particular efficacy in rendering the mind superficial; for having several times questioned the frontier Canadians respecting the distances of times and places, or measures of magnitude or capacity, I have found that, in general, they had no clear and precise ideas; that they received sensations without reflecting on them; in short, that they knew not how to make any calculation, that was ever so little complicated."—" But there is not a single American settler, who does not give with precision the number of miles, or hours, and weights and measures, in feet or yards, pounds or gallons; and who does not very readily make a calculation of several actual or contingent elements. Now this kind of practical science has very important and extensive consequences in all the operations of life; and it may surprise my reader to be informed, that it is much less common among the French, even in Europe, than he would be disposed to imagine." Volney's *View of the United States*, p. 385, &c.

The cultivation of literature, of the arts and sciences, in Canada, has almost uniformly continued in the lowest degree of degradation. It was the policy of the French government to keep the people in a state of ignorance: the general levity and dissipation of the colonists equally contributed to the discouragement of learning; and the Jesuits alone possessed any taste for the sciences, and any means of cultivating them. The progress of knowledge was not greatly advanced by the conquest of the country by the British. The first traders and settlers whom this event introduced, were little qualified to communicate a taste for literary pursuits; and an Almanac continued for many years to be the only work printed in the colony. Of late, however, the Canadians have evinced a greater inclination to favour the productions of the press; but still the whole extent of their exertions is limited to the publication of four weekly newspapers, an almanac, and the acts of the provincial assembly. Two of these papers, the Quebec and the Montreal Gazettes, are published in English and French, and contain the proclamations and edicts of the governor, advertisements of the sheriffs, &c. Other two, the Quebec Mercury and the Canadian Courant, are published in English, and resemble other periodical works of that description. Two others, indeed, entirely in French, one called *Le Canadien*, a violent political paper, and the other *Le Courier de Quebec*, rather of a literary description, and chiefly intended to give publicity to fugitive pieces, were produced for some time, but are now no longer published. There are two subscription libraries in Lower Canada; one of which is kept in the building called the Bishop's Palace at Quebec, and the other in one of the rooms of the court-house at Montreal. Both of them contain many useful and valuable works, which are yearly augmented by the liberal support afforded by the inhabitants of these towns to their respective institutions; and the good effects of these establishments are very observable in the acquirements of many young men of the country, who have of late entered into public life.

The provinces of Upper and Lower Canada were erected by his Majesty into a bishop's see, in the year 1793; but the clergy of the established church in both provinces amount only to eleven or twelve, including the lord bishop of Quebec. Within these few years, a Metropolitan church has been erected at Quebec, which is an extremely neat and commodious building, and in which there is a very fine organ. There is also a minister of the church of Scotland, both at Quebec and Montreal, who have chapels appropriated to their use, with very respectable congregations. But the great majority of the inhabitants of Lower Canada profess the Roman Catholic religion, the free exercise of which was secured to them by the act of the British parliament of the 14th year of his present majesty, c. 83; subject, however, " to the King's supremacy, declared and established by an act made in the first year of the reign of Queen Elizabeth." By the same act of the 14th of the King, the clergy of the said church may " hold, receive, and enjoy, their accustomed dues and rights, with respect to such persons only as shall profess the said religion."

By the above act, the Roman Catholic clergy in Lower Canada have obtained rights and privileges far superior to those of the same religion in any other part of the British dominions. It is nevertheless to be observed, that these advantages are held *subject to the King's supre-*

macy; which, consequently, gives to the crown the right of presentation to Roman Catholic church livings in Lower Canada, where there is no other legal authority to make such presentations. This very important right has hitherto, through connivance, been suffered to be exercised by the Roman Catholic bishop, who is always nominated by the governor or person administering the government of the province for the time being, as the representative of his Majesty. But, for want of proper authority from the crown, the parochial clergy of Lower Canada labour under very serious difficulties; and, from some suits which have of late years been brought into the provincial courts, but which have not been carried to a final issue, there is great reason to doubt whether, by legal process, they can enforce payment of tythes from their parishioners, should the latter be inclined to dispute the point. We have only to remark farther, on this subject, that the Roman Catholic clergy of this colony are more distinguished by their devout, inoffensive, and humane dispositions, than by their learning or talents; and that they are regular and rigid in the observance of their religious ceremonies; but have much less bigotry and party-spirit, than the ecclesiastics of the same church in any other country. They live on the most friendly terms with their Protestant neighbours; attend each other's baptisms, marriages, and burials, without scruple; and have ever been known to make use alternately of the same place of worship. They certainly afford a proof, as adduced by Mr Burke, that the full and complete toleration of Catholics is not necessarily followed by revolt and independence on their part; since, when all our Protestant colonies revolted and joined themselves to France, "Popish Canada was the only place which preserved its fidelity; the only place in which France got no footing." The great mass of the people are affirmed, by recent travellers and residents in the colony, to be still quiet and inoffensive, and as ready to obey any order of government as the people of Great Britain. Various measures have been proposed with a view to encourage and confirm them in their allegiance; upon the probable efficacy of which it is not our province to pronounce an opinion, and which could not with propriety be discussed in the present work; but we have been desirous, in devoting so considerable a space to the subject, to contribute our aid to attract a greater degree of the public attention to so valuable, interesting, and extensive a portion of the British dominions; and we submit the present sketch to our readers with greater confidence, as it has been honoured with a revisal, and many important additions, from gentlemen of character and ability who have resided in the colony, and who are thoroughly acquainted with the subject. See *Modern Univ. Hist.* vols. xxxix. & xl.; M'Kenzie's *Voyages in North America;* Carver's *Travels in North America;* Long's *Travels in North America;* Heriot's *Travels through the Canadas;* Grey's *Letters from Canada;* Weld's *Travels in America;* Boulton's *Sketch of Upper Canada;* Lambert's *Travels in Canada;* and particularly Sir James Marriott's *Plan of a Code of Laws for the Province of Quebec*, printed in the year 1774, and now to be had of Mr Bickerstaff, bookseller, London.* (*q*)

CANAL. See INLAND NAVIGATION.

CANANORE, CANURA, or COLANADA, a town and principality of Hindostan, lies at the bottom of a small bay on the coast of Malabar. It was very early possessed by the Portuguese, who, about the year 1605, obtained leave of the king of the country to build a fort, which they secured with a strong garrison. Having thus become a point of communication with Europe, and being well supplied by the adjoining country with abundance of rice, pepper, sugar, cardamoms, ginger, tamarinds, and other valuable commodities, it soon rose to be a populous and commercial city; and, about the middle of the 18th century, when it was under the power of the Dutch, who had established a considerable factory at this place, nearly 200 vessels arrived annually in its harbour. In 1770, Cananore was sold by the Dutch, to the ancestors of the present reigning family, for 100,000 rupees. It was afterwards seized by Tippoo Saib; but is now subject to the British, who, under General Abercrombie, took possession of the fort on the 17th of December 1790. The *Biby*, or lady of Cananore, however, who at present manages the affairs of the royal family, during the minority of her son, is still allowed to retain the nominal sovereignty of the district. She pays an annual land-tax of 14,000 rupees to the Company, and is allowed to collect all the revenues, except the customs. Her territories on the continent are very small, extending no where above two miles from the town. The surface is, in general, high and uneven; but it is all capable of cultivation, though a small part of it only is fitted for rice ground. She possesses also most of the Lacadive islands, which, however, are so wretchedly poor, that the tribute which she derives from them is altogether trifling. Her principal resources arise from trade, which she carries on to a considerable extent in vessels of her own, with Arabia, Bengal, and Sumatra; and "her commercial affairs are so well managed," says Dr Buchanan, "that she will soon, it is said, recover the losses that she is alleged to have suffered from the rapacity of some British officers, during the wars of Malabar." The town of Cananore stretches about half a mile along the shore, and is defended by a strong fortress, which was formerly considered impregnable, and several detached forts situated on every side. It is very narrow, except near the centre, where it runs a little way up into the land, and is terminated by a battery, called Spice Fort. It contains several very good houses, which are possessed by Mahometan merchants; but its eastern extremity is chiefly inhabited by fishermen, and consists only of a group of miserable huts. The fortress stands a little south-west of the town, upon a promontory, which projects about a quarter of a mile into the sea. It has the complete command of the bay; and, since the province was ceded to the Company, has been considerably strengthened with works after the European fashion. The sea surrounds it on all sides, except on the north-west, where it is separated from the land by a deep ditch and strong fortifications. It contains the wharf, where vessels may lie with great safety during summer, but, in winter, it affords very little security; a hospital, the chief's house, the warehouses, and lodgings for the different officers of the Company. The house of the present Biby is very large, and is one of the best sultan's palaces in India. Cananore still possesses a flourishing trade, though its exports have been considerably diminished by the disturbances of *Cotiote*; and it employs from 25 to 30 vessels. It is about 15 miles north-west from Tellicherry; and lies in N. Lat. 11° 55′, E. Long. 75° 14′. See Buchanan's *Journey through Mysore*, &c. vol. ii. p. 553; Bartolomeo's *Voyage*, p. 144; and a plan of the town and fort, in the *Oriental Repository*, vol. i. (L)

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* The writer of this article has been indebted to WILLIAM ELLICE, Esq. M. P. for much valuable and original information respecting Canada.

CANARA, a province of Hindostan, extends along the Malabar coast between the 12th and 15th degree of N. Lat., and is from 30 to 90 miles in breadth. It is separated from the Mysore by the Western Ghauts, and comprehends the countries of Tulava and Haiga, with a small portion of Malayala on the south, and of Kankana on the north. Its name is supposed to be an European corruption of Karnata, a people residing above the Ghauts, and was bestowed upon it, because it belonged to the princes of that nation; and we may observe, that, on the other side of the peninsula, the Carnatic received its name from the same origin, and the same cause, when first conquered by the Moslems. Though the air in this country is, in general, pure and pleasant, and the climate salubrious, yet, in some places, it is extremely unhealthy, particularly in the northern part of the province. In Tulava heavy rains and strong westerly winds prevail, between the middle of May and the middle of August. The rain which they have during the other seasons of the year comes from the east, and commonly falls in gentle showers; and, in the winter months, from November to March, the weather is dry, but the air is reckoned cold by the natives. The soil throughout this province is in general good; and produces abundance of rice, of which great quantities are exported to Europe and various parts of India. The best in quality is in the neighbourhood of the coast. In many places, it grows gradually worse as you approach the mountains, where the rains are sometimes so excessive, as greatly to injure the crops; but in the inland part of the country, it is very favourable to plantations.—Some of the mountains are covered with stately forests of various kinds of wood, among which the *teak* is the most valuable; indeed, the Western Ghauts, in general, present a very different appearance from those in the east. Instead of the naked sun-burnt peaks of the latter, the hills here, though steep and stony, are by no means rugged, but are covered with a rich mould, and, in many places, the rocks cannot be observed without digging. "The strata on the Western Ghauts," says Dr Buchanan, "are much covered with the soil; so that it is in few places only that they are to be seen. Having no compass, I could not ascertain their course; but so far as I could judge from the sun in a country so hilly, they appeared to run north and south, with a dip to the east of about 30 degrees. Wherever it appears on the surface, the rock, although extremely hard or tough, is in a state of decay; and, owing to this decay, its stratified nature is very evident.—The plates, indeed, of which the strata consist, are in general under a foot in thickness, and are subdivided into rhomboidal fragments by fissures, which have a smooth surface. It is properly an aggregate stone, composed of quartz, impregnated with hornblende. From this last it acquires its great toughness. In decay, the hornblende in some plates seems to waste faster than in others, and thus leaves the stone divided into zones, which are alternately porous and white. This rock contains many small crystallized particles apparently of iron. Below the Ghauts, the country consists of *laterite* or brick-stone; but it is much intermixed with granites and talcose argilite, which seems to be nothing more than a potstone, impregnated with more argil than usual, and assuming a slaty form."—"The strata of Tulava, near the sea coast," says the same author, "resemble entirely those of Malayala, and consist of laterite or brick-stone, with a very few rocks of granite interspersed. This granite is covered with a dark black crust, and is totally free from veins of quartz, or of felspar. In many places, large masses of the granite, immersed in the laterite, are in a state of decay; the black mica has entirely disappeared, and the white felspar has crumbled into powder, leaving the quartz in angular masses. These sometimes form so large a share of the whole rock, that, after the decay of the other component parts of the granite, they firmly adhere."

In Tulava, all the lands are private property; but in Haiga, the hills and forests, and in Soonda, a district of Kankana above the Ghauts, the arable land belongs to government. Every man pays a certain land-tax, and cultivates his property in whatever manner he pleases. Some of them let their lands upon a lease of from four to ten years; and the rent demanded is generally two *morays** of rice for every moray of land of the first quality; one and a half for middling land; and one for the worst land. The most wealthy cultivators keep from 20 to 25 ploughs; those in moderate circumstances have from four to six; but the greatest proportion of farmers have only one. All agricultural labour is performed by hired servants and slaves. Of the former, a man is allowed 2 *hanies* of clean rice per day, or 21¾ bushels in the year, with 1½ rupees worth of cloth, a pagoda in cash, and a house; and a woman the same quantity of cloth, and three-fourths of her husband's allowance of grain. A male slave has 1½ hanies of rice a-day, with an annual allowance of 2½ rupees worth of cloth, and is permitted to build a hut in the cocoa-nut garden; a female has only 1 hany per day, with the same quantity of cloth.

Most of the cultivated lands of this country are sown with rice. Of this plant they have a great variety of kinds, each of which requires a particular soil, and a particular method of culture. Some of them produce three crops in the year, others only one; and they differ greatly from each other, both in the quantity of the produce, and in the quality of the grain. As much of the rice ground is equally adapted for the rearing of sugar canes, the cultivation of this article might be increased to a considerable extent; but the farmers consider rice a more profitable crop, particularly since the late reduction of the duties upon its exportation; and consequently the sugar is comparatively neglected. Cocoa nuts, betel nuts, mangoes, pepper, cardamoms, turmeric, ginger, &c. are produced in great abundance; and several cu-

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* The *moray* or *mudi*, a dry measure of Canara, is equal to $1\frac{2526}{10000}$ bushel; and the *moray*, or land measure, is equal to 49,005 square feet, or nearly $1\frac{13}{100}$ acre.

curbitaceous plants, with a variety of kitchen stuffs, are cultivated in almost every garden. Black pepper grows spontaneously in the woods, and wild nutmeg and cinnamon are very common. The forests abound with sandal, teak, and sissa trees, which furnish a considerable revenue to government.

In the southern division of the province there were in 1800, 247,218 morays of rice land in a state of cultivation, which employed 71,716 ploughs; and, besides forests, it contained 111,965½ morays capable of culture, of which 24,181 morays were cleared for grass, 7043 were capable of being converted into rice ground, and 1789 were fit for gardens. According to a survey made in 1793, the garden ground of this division contained 695,060 cocoa nut trees; 1,155,850 betel nuts; 59,772 mangoes; 368,828 pepper vines, and 54,362 of other descriptions. Since that time, however, it is supposed that the number of each kind has been fully doubled. In the northern division, the proportion of lands under cultivation, and those capable of being so, are, to the sterile lands, nearly as 26.7 is to 73.3. The number of ploughs in 1801, were 26,147, and the quantity of sugar annually produced, was estimated at about 11,483 *maunds* of nearly 30 lb. each. The produce of the waste lands in this division, according to the statement of the collector of the revenue, is contained in the following tables:

IN THE DISTRICTS BELOW THE GHAUTS.

Sandal wood trees			10,143
Teak trees, cut annually			3,183
Sissa trees, do.			2,498
Honey, annually,	8	maunds.	
Wax, do.	2	do.	7½ seers.
Wild cinnamon, do.	123	do.	35 do.
Cabob China,* do.	118	do.	36½ do.
Nutmegs, do.	40	do.	22½ do.
Wild pepper, do.	1058	do.	38¾ do.

IN THE DISTRICTS ABOVE THE GHAUTS.

Sandal wood trees			12,893
Teak trees			396,113
Sissa trees			64,588
Honey, annually	53	maunds.	14 seers.
Wax, do.	72	do.	7½ do.
Wild cinnamon, do.	17	do.	30 do.
Cabob China, do.	49	do.	10 do.
Wild pepper, do.	34	do.	8 do.

Buffaloes and oxen are almost the only cattle in Canara; and are chiefly bred in the districts near the Ghauts. Good cows are very scarce, and are in general wretchedly kept. A few swine are fed by some of the lower casts; but the inhabitants rear neither horses, sheep, goats, nor asses. Tigers are, in some districts, very numerous, but there are no elephants. The number of horned cattle in the province is supposed to amount to 420,569, of which 97,356 are buffaloes.

The commerce of Canara, since the country became subject to the Company, and was thus freed from the ruinous exactions with which it was loaded by the sultans of Mysore, has begun to assume a more active appearance. Many wealthy merchants from Surat, Cutch, Bombay, and other places towards the north, have come to settle in the province; and many of the inhabitants, who were formerly deterred by the oppressions of the government, and were even obliged to leave the country, are now beginning to return and to engage in commerce. Few vessels, however, belong to this province, and those which are employed in its trade chiefly belong to other ports. Rice is the grand article of exportation; which, together with betel-nut, cocoa-nut, pepper, sandal-wood, cinnamon, Cabob China, cut (terra Japonica) and turmeric, form a very lucrative traffic with Surat, Bombay, Muscat, Cutch, Goa, Malabar, and the Marattah countries above the Ghauts. The principal imports are blue and white cotton cloths from Surat and Cutch; salt from Bombay and Goa; raw silk and sugar from China and Bengal; a kind of red dye, called *munjisht*, from Muscat; and oil and *ghee* (boiled butter) from Surat. Great quantities of cloth are also brought from above the Ghauts by the Marattah merchants, and those of Bangalore and Cuddapa.

A statement of the exports and imports by sea in the southern division of Canara for two years during the government of the sultans, and for one since it came into the possession of the Company, will shew how much the commercial prosperity of the country has increased by a change of government.

	Exports.			Imports.		
	Pagodas.	Fans.	Anas	Pagodas.	Fans.	Anas.
In 1788	58.581	4	2½	39.118	5	14¾
1790	68.903	0	3	13.641	6	2
1795	172.427	2	10	84.461	7	13

The principal articles of commerce during the last of these years, is contained in the following table, which is selected and abridged from the revenue accounts given by Dr Buchanan in his Journey from Madras through Mysore, &c.

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* Cabob China are the buds of the cinnamon tree.

A STATEMENT OF THE EXPORTS AND IMPORTS BY SEA, IN THE SOUTHERN DIVISION OF CANARA, FOR 1795.

ARTICLES.	EXPORTED.						IMPORTED.					
	Quantity.[*]			Price.[†]			Quantity.			Price.		
	Corges.	Morays.	Hanies.	Pagod.	Fan.	Anas.	Corges.	Morays.	Hanies.	Pagod.	Fan.	Anas.
Rice, ...	7080	11	21	141605	4	6	69	20	—	1389	5	4
	Candies.	Maunds.	Seers.				Candies.	Maunds.	Seers.			
Blackpepper, . .	460	12	20	15200	6	4	49	17	—	1641	7	8
Betel-nut, . . .	144	19	25	1739	7	12	61	14	—	740	4	—
Sugar-candy, . .		3	10	6	5	—	16	12	30	713	8	—
Camphor, . . .	...	...	...	...	...	...	—	17	7⅛	328	1	5
Incense, ...	...	...	...	...	...	...	—	8	10	29	4	6
Cummin-seeds, . .		1	30	1	7	10	8	15	—	173	9	15
Sealing-wax, . .	1	16	20	39	5	6	—	5	—	7	–	—
Cathilla, ...	...	...	...	...	...	...	12	7	30	776	1	14
Asafœtida, . . .	...	...	...	...	...	...	1	6	20	156	9	11
Tamba, *Pittal*, and *Kassaund*, ...	...	...	...	...	...	...	3	8	—	330	8	12
Silk thread, . . .	...	...	...	...	...	...	—	9	9¼	231	1	2
Candles, ...	...	...	...	...	...	...	3	3	27½	364	5	14
Drashum, . . .	2	5	—	19	8	2	13	9	13½	120	4	2
Jasta Mathoo, . .	5	9	—	38	1	8	6	14	—	50	2	8
Soap, ...	...	...	...	...	...	...	17	9	—	211	1	12
Tobacco, ...	...	...	...	...	...	...	104	2	10	1530	6	6
Sanapoo, ...	.	...	...	...	...	...	11	18	10	113	3	3
Flowers of Hemp, .		3	—	2	8	8	17	11	—	331	7	8
Cinnamon, . . .	6	—	—	42	4	—	—	1	—	—	3	—
Ayaputty, . . .		1	—	4	5	—	15	5	38¼	1015	2	8
Coriander seeds, .	3	3	20	24	3	—	1	11	20	16	–	12
Onions, ...	...	...	...	...	...	...	107	1	—	486	9	13
Oil, ...	...	...	...	...	...	...	374	5	20	383	7	13
Cocoa-nut kernels .	4	15	—	41	5	10	133	2	20	1577	9	3
Garlick, ...	27	18	11¾	164	6	15	1	4	—	7	2	—
Gudd, or *Jagory*, .	2	18	11¾	23	1	1	2	15	25	16	3	15
Cordage, ...	28	19	30	153	–	14	160	18	5	951	9	6
Tamarinds, . . .	...	...	...	...	...	...	19	3	—	91	5	2
Capsicum, . . .	25	1	4½	176	2	1	3	14	30	20	8	—
White thread, . .	5	9	10	22	0	14	—	5	21½	11	4	6
Dates, ...	12	4	30	83	9	12	56	3	10	414	4	3
Jashawn, ...		13	30	27	5	—	1	9	30	92	8	6
Sandal oil, . . .		7	20¾	160	–	—	—	14	7¾	172	4	4
Madder, ...		19	20	220	5	9	4	3	10	70	7	10
Almonds, ...	1	15	—	27	6	4	5	14	20	91	4	11
Cupper Sooth, . .	...	...	...	...	...	...	4	2	10	115	1	8
Ghee, or boiled butter,	...	...	...	...	...	...	51	1	20	1533	5	—
Paupdah Caur, . .	...	...	...	...	...	...	5	17	20	33	9	14
Dates, 2d. . . .	14	4	20	70	9	12	189	4	--	1078	2	10
Rose water, . . .	...	...	...	...	...	...	1	17	—	21	2	12
Sandal wood, . .	3	10	20	92	7	—	—	3	32	4	7	3
Cloves, ...	...	...	...	...	...	...	—	3	30	72	5	—
Puthry, ...	...	...	...	...	...	...	1	1	3	60	6	14
Ralli Dub, . . .	...	...	...	...	...	...	4	17	20	37	3	12

[*] As many of the weights and measures of the Hindoos, though called by the same denomination, vary in quantity according to the different purposes to which they are applied, it is difficult to ascertain the exact value of each. In order, however, to give our readers some idea of them as they are used in the foregoing Table, we observe, that the standard *Seer* weight, or Indian pound, should weigh 24 Bombay rupees, making nearly nine ounces avoirdupois, but these pieces being rather a scarce article in Canara, the merchants commonly use *Dubs*, or *Dudus*, which are somewhat heavier, and consequently raise the Seer to about 9.75 ounces. Of these Seers, 44 is supposed equal to one *Maund* or *Mana:* and 20 Maunds make one *Candy*, or nearly 540 lb.

The *Hany* used in this Table is a measure of capacity of $64\frac{125}{1000}$ cubical inches, of which 42 make a *Moray;* and 42 Morays are equal to one *Corge*, or about 52 bushels.

[†] The value of the Pagoda is about 8s. sterling. It is divided into 10 *Fanams* or *Hunas;* which are again subdivided into *Anas*, or fractions of 16 parts.

ARTICLES.	EXPORTS.						IMPORTED.					
	Quantity.			Price.			Quantity.			Price.		
	Candies.	Maunds.	Seers.	Pagod.	Fan.	Anas.	Candies.	Maunds.	Seers.	Pagod.	Fan.	Anas.
Cotton, ...	1	2	20	23	3	7	6	15	20	145	4	2
Iron, ...	6	11	30	91	9	2	—	—	27¾	1	-	—
Minbassy, . . .	...	...	...	...	...	...	6	—	20	45	1	14
Sugar, ...	72	3	30	443	7	8	200	12	—	3937	5	10
	Corge, or score by number.						Corge, or score by number.					
Cloths of various kinds,	47		17½	834	8	8	2214		15¾	38678	5	5
Taffetas, ...	...	...	...	...	...	...	24		3¾	853	-	5
Turbans, ...	...	...	...	...	...	...	8		8¾	147	7	15
Shawls, ...	...	...	...	...	...	...	3		10	367	-	—
Looking-glasses, .	...	...	...	...	...	...	166			45	1	7
Rose-water glasses,	...	...	...	...	...	...	118			22	5	1
Matts, ...	...	...	...	...	...	...	233000			466	-	—
Fish, ...	100			6	7	8	27113			473	4	10
Paper, in reams, .	34½			68	6	—	195			390	-	—
Cocoa-nuts, . . .	...	...	...	...	...	...	806585			4286	9	8
Box, ...	...	...	...	...	...	...	47			587	5	—
Wine, or Leaguer of Liquors, . . .	...	...	...	...	...	...	48			1120	-	—
Large matts, . .	...	...	...	...	...	...	143			39	7	14
Raw Betel-nuts, .	19000			4	7	8	247550			61	8	14
Horses, ...	...	...	...	...	...	...	2			20	-	—
Sulleh Thaunoo, .	...	...	...	...	...	...	55¼			312	7	8
Handkerchiefs, . .	...	...	...	...	...	...	764	corge and	3	1068	1	13
Shoes, ...	...	...	...	...	...	...	8	do.	15	23	2	—
Poth Custy, Many Sur,	...	...	...	...	...	...	77	do.	10	31	1	5
Cocoa-nuts, 2d. .	...	...	...	...	...	...	60161			189	3	12
Matts of cocoa-nut leaves, ...	...	...	...	...	...	...	2456			64	1	9
Paper bundles, . .	...	...	...	...	...	...	72½			51	4	4
Wood, ...	...	...	...	...	...	...	133	corge and	5	53	-	3
Thutty Boriah, . .	...	...	...	...	...	...	327	do.	2	96	9	12
Spectacles, . . .	...	...	...	...	...	...	45	do.	18	34	6	14
Silk umbrellas, . .	...	...	...	...	...	...	4	do.	3	57	-	14
Pingany Dobey, .	...	...	...	...	...	...	405	do.	4½	78	1	12
Hat feathers, . .	...	...	...	...	...	...	24	do.	9	43	7	8
Looking-glasses covered with paper, .	...	...	...	...	...	...	94	do.	17	43	8	9
Sunth Thugdoo, .	...	...	...	...	...	...	53	do.	11	32	6	—
Ivory combs, . .	...	...	...	...	...	...	67	do.	5	38	2	7
Paper umbrellas, .	...	...	...	...	...	...	49	do.	16	111	3	8
Saffron, ...	59 can. 5 ma. 30 seers.			414	9	14						
Adokdy, ...	200			25	-	—						
Gunney Bindeh, .	227			20	4	6						
	Corges.	Mor.	Han.				Corges.	Mor.	Han.			
Withulla, ...	3	19	—	63	5	9	128	21	30	3438	9	—
Churudahy, . . .	...	...	...	9339	8	7				2229	9	6
							Cumba.	Solagic.	Do.			
Salt, ...	...	...	...	...	...	...	31	5½	2½	2619	4	8
SUNDRIES, amounting to	...	...	...	1099	8	9	...	...	...	4540	6	5
	Total, ...			172,427	2	10				84461	7	13

The exports of this division by land consist chiefly of salt, salt-fish, betel-nut, ginger, cocoa-nuts, cocoa-nut oil, and raw silk to the annual amount of 20,388 pagodas; and its principal imports are cloths, cotton, thread, blankets, tobacco, black cattle, and sandal-wood, to the value of 37,455 pagodas.

The commerce of the northern division of the province is equally flourishing, as will be seen from the annexed tables; the first of which contains the average annual exports and imports by sea of the northern districts below the Ghauts, in the years 1800-1, and the other is a statement of the land commerce of the whole division for the same years.

THE AVERAGE ANNUAL EXPORTS AND IMPORTS BY SEA, IN THE NORTHERN DIVISION OF CANARA BELOW THE GHAUTS, FOR 1800—1.

ARTICLES.	EXPORTED.				IMPORTED.			
	Quantity.*			Price.	Quantity.			Price.
Rice, cleaned, . .	2363¾ corges.	5¾ morays.		141,837 rupees.	2 corg.	3½ morays.		118 rupees.
Do. rough, . . .	650¾	0½		19,523	64¾ do.	5 do.		1687
Ragy, (Cynosurus)	23¼	1		716	...	...	...	... ...
Pulse of various kinds	47¾	4		3025	1½ do.	18 do.		260
Wheat	3½	0		14	1½ do.	8½ do.		244
Salt	0	3105		621	0 do.	7643½ do.		2419
Oil	12¼ ca.	3 ma.	6½ seers.	731	3 ca.	1 ma.	10 seers.	165
Ghee, boiled butter	0	3¾	0¼	24	1	2	9	149
Betel-nut, 1st sort .	195½	0¼	10¾	11,740	1½	0¾	0	72
Do. 2d do. .	896	2½	6	36,577	...	...	...	... ...
Do. 3d do. .	128¼	3¼	8½	4688	...	...	...	... ...
Do. 4th do. .	1,538,605 pieces.			620	98,500 pieces.			78
Pepper	278¼ ca.	3¼ ma.	9 seers.	28,030	0¼ ca.	4 ma.	0 seers.	50
Cardamoms . . .	...	...	...	... ...	0	4½	5	138
Jagory of sugar-cane	54	1	0	1100	128	3¾	0	366
Palmira Jagory . .	437 pieces.			136	...	...	...	... ...
Turmerick . . .	17½ ca	4½ ma.	0 seers.	476	0	4½	0	5
Coriander seed . .	6¼	4¾	0	204	3¾	0½	0	108
Onions	8½	1½	0	103	10½	3	0	102
Chillees or *Capsicum*	66¾	1	8	2184	5½	3½	0	162
Cinnamon . . .	4	4	0	81	...	...	...	... ...
Do. flowers . . .	10½	4	0	252	...	...	...	... ...
Dry cocoa-nuts . .	2½	2½	0	95	42¼	2½	0	1349
Tamarinds . . .	11½	2¼	0	114	3¾	1½	0	44
Ginger	...	...	...	... ...	1½	1½	0	94
Cocoa-nut rope . .	214¾	2	5	4170	...	...	...	... ...
China sugar . . .	2¼	2	0	235	11¾	2½	0	960
Sugar-candy . . .	...	...	...	... ...	1½	3¾	5	270
Dry dates . . .	...	...	...	... ...	61½	5	0	1364
Dates	...	...	...	... ...	312½	4¼	0	4522
Camphor	...	...	...	... ...	0	4½	0	176
Benjamin	...	...	...	... ...	0¼	3	0	80
Tin	...	...	...	... ...	6½	1¼	0	1290
Soap	...	...	...	... ...	2	0½	0	162
Wax	1	2½	1	180	0¼	0¼	3	43
Asafœtida . . .	...	...	...	... ...	0	3½	1½	990
Cauvee or paint . .	...	...	...	... ...	5½	2½	0	120
Paring Chucka . .	...	...	...	... ...	2	0	0	80
Fish	1	4¾	0	288	...	...	...	... ...
Iron	140 pieces.			28	400 pieces.			80
Gopee Chundenum .	0¼ ca.	3 ma.	0 seers.	3	10 ca.	3½ ma.	0 seers.	129
Copper	...	...	...	... ...	0¾	4½	4½	300
Brass	...	...	...	... ...	0½	4½	0	145
Cotton	...	...	...	... ...	1	2	0	88
White thread . .	0½	0	0	180	...	...	...	... ...
Twine	...	...	...	... ...	6¼	2½	0	133
Tobacco	6	4¼	0	745	105½	0¼	3¼	8508
Sealing-wax . . .	...	...	...	... ...	0½	0¼	3	103
Blue cloths . . .	...	...	...	... ...	55¾ kod.	5 tak.	0 pieces.	3720
Silk do.	...	...	...	... ...	1½	45	0	680
Case shawls . . .	...	...	...	... ...	0	40	0	560
Nankeen	...	...	...	... ...	6½	4½	0	400
Nar Muddee . .	...	...	...	... ...	8¼	37	0	202
Chints	...	...	...	... ...	3	5¼	0	130

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* The *Seer* measure, in the two last tables, is 73.683 cubical inches, of which 51½ make a *Moray*, and 1470 a *Corge*. The Candy, Maund, and Seer weight, are the same as before stated; the *Tak* is equal to 40 cubits; the *Load* is the common burden of a man; and the *Rupee* is valued at about 2s. sterling.

ARTICLES.	EXPORTED.					IMPORTED.				
	Quantity.			Price.		Quantity.			Price.	
White blankets . .	...	...	...	...	...	12¾	1	1	257	
Black do.	...	...	...	...	...	6½	0	5	80	
Musrooms . . .	...	...	...	...	...	1¼	57	0	698	
China Peelown . .	...	...	...	...	...	1¼	3	0	290	
Soorlee Thaun . .	...	...	...	...	...	0¼	0	0	125	
Dummas	...	...	...	...	...	0¼	5	0	310	
Mooemall	...	...	...	...	...	0	2	0	120	
Mooctay cloth . .	...	...	...	...	...	0½	40½	0	202	
China handkerchiefs	...	...	...	...	...	3¾	36¾	0	1163	
Canvas	...	...	...	...	...	6	0	0	180	
Red *Dungree* . .	...	...	...	...	...	2½	4	0	88	
Kinkop (silk cloth)	...	...	...	...	...	0	2	0	100	
Silk woman's cloth	...	...	...	...	...	0	91½	0	940	
Kelkee Do. . . .	...	...	...	...	...	0	21	0	147	
Howrunga Jubbee Thaun	...	...	...	...	...	0	9	0	90	
Turbans	...	...	...	...	...	1½	66	0	1274	
China ware . . .	...	...	...	...	...	16	0	111	431	
Salt fish	...	...	...	...	...	0	0	8	154	
Cocoa-nuts . . .	48,795			975		172,399			4000	
Country paper, reams	...	...	...	...	...	60¾			607	
Betel leaf bundles .	6000			6000		17½			26	
Buhder Buttoo . .	32¾ candies.			200		...	...	...	...	...
Mummeeties . . .	140 pieces.			140		...	...	...	...	...
Matts	318			318		...	...	...	...	...
Sandal wood . . .	803 ca.	6¼ ma.	5 seers.	64,660		...	...	...	...	...
Sundries, to the amount of . . .	...	...	...	19,839		...	...	...	2428	
Total	...	...	...	331,532 rupees.		...	...	...	44,585 rupees.	

THE ANNUAL EXPORTS AND IMPORTS BY LAND, IN THE WHOLE NORTHERN DIVISION OF CANARA, 1800—1.

ARTICLES.	EXPORTED.		IMPORTED.	
	Quantity.	Price.	Quantity.	Price.
		Rupees.		Rupees.
Salt	111264 maunds	74176	36034 maunds, and 30 loads	18128
Oil seed	18 do.	24	366 maunds	190
Sweet oil	....	....	1494½ maunds, 5 seers, and 1 pot	5985
Cocoa-nut oil . .	1274¾ pots	12740	1171½ maunds, 7½ seers, and 1140½ pots	13810
Sandal-oil . . .	....	....	5¾ maunds	1265
Chillees (*Capsicum*)	....	....	3048¾ maunds, and 7 loads	4070
Tamarinds . . .	96 maunds	96	258 maunds	130
Onions	....	....	177 do.	90
Coriander seed . .	....	....	105 do.	158
Turmerick . . .	97 do., 3 loads	156	....	....
Cut (terra Japonica)	184 maunds, and 4 load	555	262 maunds, 5 seers, and 8½ load	685
Dry cocoa-nuts . .	955 maunds	3820	49 maunds	147
Dates	817¾ maunds	2453	713 maunds, and 27 load	1472
Dry dates . . .	153 do.	612	....	....
China sugar . . .	....	....	141¾ maunds, and 1 load	1460
Ghee, (boiled butter)	....	....	24 maunds	168
Honey	24 maunds, and 1 load	114	....	....
Wax	181½ ma., 2½ seers, and 2 loads	2017	....	....
Cotton	....	....	81¾ maunds	163
Cinnamon . . .	84 maunds	252	....	....
Brimstone . . .	....	....	288 maunds	864
Cocoa-nut . . .	9216 maunds, and 431 loads, and 76774	12508	16944 maunds, and 2010 load, and 57	19247

ARTICLES.	EXPORTED.		IMPORTED.	
	Quantity.	Price.	Quantity.	Price.
		Rupees.		Rupees.
Toddy (palm-wine)	287½ pots	575	2 pots	4
Iron bars. . . .	....	....	393 ma. and 320 pieces	1422
Cocoa-nut cordage	64 maunds, 7 load, and 56½ pieces	143	220¼ maunds, and 24 load	474
Silk thread . . .	....	....	2 maunds	3568
Silk	1 load	200	14 pieces	140
Black blankets . .	....	....	597 maunds, 7 load, and 483 pieces	10610
Red paint . . .	105 maunds, and 67 load	100	6 maunds	9
Tobacco	53 maunds	88	1942 maunds, 5 seers, and 2 load	5830
Jagory	1077 maunds	2154	1810¼ maunds	1810
Sheep	....	....	983	1475
Utchada cloth . .	....	....	1139 pieces	2272
Jack stones of the Artocarpus	15 load, and 29	158	....	....
Betel leaf . . .	310 load	31	282 maunds, 103 load	319
Dooleys (litters) .	3	1734	....	....
Horses	67	4110	....	....
Cattle	....	....	574	11560
Mangoes	84 maunds, and 73 pieces	1470	....	....
Betel nut, 1st . .	121818½ maunds, 9½ seers	618081	....	....
Ditto, 2d sort . .	14959 ...... 5½	59836	....	....
Ditto, 3d sort . .	2022½ ...... ¾	5356	....	....
Pepper	16200¼ 7¼	109863	....	....
Cardamoms . . .	1459¾ 8½	48664	....	....
Sandal wood . . .	12332 ...... 0	1024	....	....
Sundries to the amount of . . .	....	1123	....	10515
	Total,	963833		108045

From these tables we may deduce the following statement, which shews the extent of the balance of trade in favour of this country, in sterling money, estimating the pagoda at 8s. and the rupee at 2s. sterling.

Commerce.	Exports.	Imports.
By sea in South Canara .	L. 68,970	L. 33,784
By land	8,155	14,982
By sea in North do. .	33,153	4,458
By land	96,383	10,804
Total	L. 206,661	L. 64,028
Balance in favour of the province . .	L. 142,633	

The revenue which the Company derives from this country, arises chiefly from the duties upon commerce and the land-tax; and the produce of these, we may conclude, is very considerable, as the sea customs of the southern division alone amounted, in 1795, to 23,760 pagodas, 5 fanams, and 14 anas, being about 9504*l.* sterling. In Tulava, the land-tax, or *shista*, as it is called by the inhabitants, was formerly demanded in rice, and other articles of consumption, for the troops, at a low rate; but since the conquest of the country by the British, it has been paid in money, and the part of Malayala, which is contained in Canara, yielded, in the first year of the Company's government, 6000 pagodas. We are unable, however, to give the full amount of this tax; but we may with safety state it at about one-fourth of the gross produce of the lands.

Canara, before its subjugation by the Sultans of Mysore, was possessed by several independent rajas. Many of these, upon its first conquest by Hyder Ali, were permitted to retain the entire management of the country, on paying an annual tribute, which they raised by a land-tax; and even when this permission was withdrawn, they still enjoyed some valuable privileges. Considerable allowances were granted to the temples and Brahmans; and the Christians, of whom great numbers of Kankana descent had settled in Tulava, possessed, in quiet, many valuable estates in land. Upon the accession of Tippoo, however, to the throne of his father, these allowances were reduced, and the estates of the Christians confiscated; their priests were also thrown into dungeons, their churches destroyed, and the laity forcibly converted to Islamism. But the native chiefs were never so entirely subdued by the Mahometan powers as the greater part of the Hindoos, and have always been able successfully to resist the pretensions of their governors to be proprietors of the soil. Upon the fall of Seringapatam, and the death of Tippoo, when this country came into the possession of the British, they were even disposed to try how far they could assert their independence, and refused for a time to settle with the British collector of the revenue, until some decisive measures were adopted to punish the most obstinate and troublesome. The country is now governed by the servants of the Company.

The inhabitants of Canara are chiefly Hindoos, and are divided into casts as in other parts of India, each of which has its peculiar manners and customs. But such is the state of society in this country, that the chastity of their women cannot be depended upon; and in order to secure the succession of property in the family, it is a common law in Tulava, that a man's own children cannot be his heirs. He may give them money during his life-time, but all that he dies possessed of goes to his sisters and to their children. Polygamy is admitted, and is generally practised. A man, however, may turn away any of his wives whenever he pleases, though a woman cannot leave her husband's house without his consent. She then retires to her brother's, and may marry again. In some cases, if a man's sister be living in his house, she assumes the active management of it, and his wives have no authority. Their language is rather peculiar, and is called Canarese. It differs considerably from the Tamul, or what is called the Malabar language by the Europeans at Madras, though they are evidently branches of one dialect. Their written characters are nearly the same, but in the Canarese there is a great admixture of words from different languages.

In the southern division of Canara, there are 79,856 houses, of which 2545 are inhabited by Christians, 5223 by Mahometans, and the rest by Hindoos and Pagans. The total population of this district is 396,672, of whom 206,633 are males, 190,039 females, and 7924 slaves. The houses in the northern division amount to 41,380, of which the Christians possess 476, the Mahometans 2300, and the Hindoos and Pagans the remainder. The number of slaves is about 1544. The principal towns in Canara are Mangalore and Carwar. See Buchanan's *Journey from Madras through Mysore, Canara, and Malabar*, vol. iii.; Dellon *Voyage aux Indes Orientales*, p. 195, &c.; and Bartolomeo's *Voyage to the East Indies*, p. 103. (*p*)

CANARINA, a genus of plants of the class Hexandria, and order Monogynia. See BOTANY, p. 178.

CANARIUM, a genus of plants of the class Diœcia, and order Pentandria. See BOTANY, p. 330.

CANARY ISLES, a group of islands in the Atlantic Ocean, which are supposed to be the same with the *Insulæ Beatæ*, or Fortunate Isles, of the ancients. They lie about 150 miles west from the coast of Africa, between 27½ and 30 degrees N. Lat. and are seven in number, viz. Lancerota, Forte Ventura, Grand Canary, Teneriffe, Gomera, Hierro or Ferro, and Palma, besides the small islands of Allegranza, Santa Clara, Graciosa, Roca, and Lobos.

These islands, though particularly described by Ptolemy and the Elder Pliny, and though their situation was accurately pointed out by Strabo, remained unknown in Europe after the decline of the Roman empire until near the middle of the 14th century; and the first account which we have of the Canaries, is from the grant of Pope Clement VI. who bestowed them upon Don Louis de la Cerda, with the title of king, upon condition that he should cause the gospel to be preached to the natives. This grant, however, was never acted upon, owing to the death of Don Louis; and nothing farther was done towards the reduction of these islands till the beginning of the following century. During this interval, the island of Lancerota had been several times visited and plundered by private adventurers, who, in one of these expeditions, carried off a large booty of goat-skins, tallow, and sheep, with about 170 of the inhabitants, among whom were the king and queen of the island. In 1400, a fleet was equipped at the private expence of John de Betancour, a Norman baron, and Gadifer de la Sala, an inhabitant of Rochelle, for the sole purpose of visiting the Fortunate Isles. When they landed at Lancerota, the natives, dreading that they were come with the same hostile intentions as their former visitors, retired into the country; but observing that the French remained in the same situation for several days without attempting to molest them, they took courage, and even ventured within the camp, where they were so kindly treated by the chiefs of the expedition, that, laying aside all apprehensions, they chearfully assisted the French in erecting a fort, which was built at the port of Rubicon. Pleased with the ready obedience and quiet demeanour of the inhabitants, John de Betancour determined to pass over to the neighbouring island; but here he met with a different reception from what he had experienced at Lancerota. The inhabitants were much stronger, and of a more warlike disposition; and gathering in great numbers, compelled him to re-embark. Finding that it would be impossible to accomplish the conquest of these islands with such a handful of men, he set sail for Spain, in order to procure fresh supplies; and to render more unquestionable his right of conquest, he obtained a grant of the Canaries from Don Henry III. then King of Castile. During his absence, the friendly intercourse between the French and the inhabitants of Lancerota had been broken by the cruel and licentious behaviour of the garrison which he had left behind; and such was the consequence of the rupture, that the Europeans shut up in the fort were reduced by famine to such an extremity, that they must soon either have surrendered or perished, had they not been relieved from their perilous situation by the arrival of their commander, who soon restored tranquillity to the island, and established anew a good understanding with the natives, who were left in the full enjoyment of their houses, cattle, and liberty. A church was built at Rubicon, named the Invocation of St Marcial; and Guadarfia, the King of Lancerota, with many of his subjects, were converted to the Romish faith, and received the ordinance of baptism.

Betancour so won upon the affections of these islanders, by his kindness and attention, that they looked upon him as a father rather than as a conqueror, and he found in them some of his most faithful followers. By the same courteous behaviour he gained the confidence and friendship of the inhabitants of Forte Ventura, who also embraced the religion of their conquerors; but in his attack upon Grand Canary, he was received with such open hostility, and opposed with such determined courage, that he was compelled to retire with considerable loss. His attempt upon Palma was equally unsuccessful. These failures, however, were compensated by the friendly and joyful reception which he experienced from the inhabitants of Gomera and Ferro, who, without the least opposition, but rather with chearfulness, gently sunbitted to his government. Perceiving that with his slender means it would be impossible to extend his authority, in their present state of watchful hostility, over the other islands, he again embarked for Spain in 1408, to solicit assistance from the King of Castile, by whom he had formerly been so liberally supported. But wishing, before his departure, to settle the government of those which had already submitted, he made a partition of the lands among his followers, reserving to himself a fifth part of the produce, and appointed his nephew, Mason de Betancour, governor of the islands in his absence. Death, however, prevented his return; and with him fled for a time the prosperity and tranquillity of the Canaries. His successors had neither his abilities nor dispositions. All their measures were marked with severity, deception, or injustice; and the only enterprises undertaken against the unconquered islands were merely for the purpose of making prisoners, which were sent to Spain and sold for slaves. By his arbitrary conduct, Mason de Betancour became daily more unpopular among the natives; and he found himself at last so unpleasantly situated, that he disposed of all his possessions in the Canaries to the Count of Niebla, in 1418, and retiring to Madeira, he infamously sold them over again to the Infant of Portugal in exchange for some lands in that island, which transaction was afterwards productive of considerable contention between the courts of Portugal and Castile. Repeated attempts were now made for the reduction of Grand Canary, but all without effect. The Canarians wanted neither conduct nor courage. They defended themselves with such resolution, that the conquest was in a manner deemed impracticable: and the only advantage that was gained by the Europeans, after nearly 60 years of almost incessant hostilities, was the building of the fort of Gando, and even this was obtained by intrigue more than by force. The difficulty of this conquest had excited the attention of the court of Spain, who viewing the unconquered islands with rather a covetous eye, and wishing to add them to the Spanish crown, pretended that the present governor Diego de Herrera was unable to subdue them by his own power, and consequently that he should cede them to their Catholic Majesties, in order that their reduction might be speedily completed, and the natives brought to the Christian faith. This cession was made in the year 1476, when Diego de Herrera received in lieu of his right five millions of maravedis, (about 3000l.)

The honour of Spain was now staked in the enterprize; and an armament, consisting of 900 foot, and 30 horse, under the command of Don Juan Rejon, was dispatched for the reduction of Grand Canary. This expedition was well equipped, and provided with every necessary, and accompanied by Don Juan Bermudas, dean of Rubicon, a person well versed in the affairs of the Canary Isles. The troops were landed, without opposition, on the 22d of June 1477, and their tents were pitched in a commodious plain, where now stands the city of Palmas. To secure themselves from any sudden attack of the natives, they immediately proceeded to build a castle, and to throw up a fortification around their camp. The Canarians, among whom considerable differences had existed, respecting the usurpation of some of their chiefs, seeing the determination of the Spaniards to settle in the island, laid aside all private animosities, and, uniting their forces, advanced to the expulsion of the enemy. They encountered the Spaniards with the fury of men whose liberty and religion were at stake; and displayed, in every attack, the most heroic and obstinate resistance. For three hours the battle continued without any apparent advantage on either side; but the Canarians were unable to withstand the fire-arms of the Spaniards, and were compelled to retreat, which they did in good order, with the loss of 300 men killed, and their bravest chief Adargoma, who was wounded and taken prisoner. After this battle, which was called the battle of Guiniguada, the natives, in some measure terrified by the sight of the horses, which had appeared for the first time in the island, did not attempt to engage the Spaniards again on level ground, but retiring to the mountainous parts of the country, contented themselves with continually harassing the enemy, in their marches, and foraging excursions. This species of warfare continued for nearly six years, during which time the Spaniards had received frequent reinforcements. The Canarians were determined to persist rather than submit. In many of their conflicts they had come off victorious; and their courage had been roused, and their hatred inflamed, by the bad faith of the enemy, who had trepanned about 200 of their subjected countrymen out of the island, under pretence of sending them to the reduction of Teneriffe, and carried them to fight against the Moors in Barbary, where they all perished. Jealousies and contentions had also existed among the Spanish officers, and before the object of the expedition was accomplished, three different governors had been sent out to Grand Canary. Their progress, however, though slow, promised them a successful conclusion; the greatest part of the island was in their possession; and the natives were reduced to their last strong hold. Six hundred Canarian warriors, with about a thousand women and children, had assembled at the mountain of Ansite, a place deemed impregnable, with the resolution of losing their liberty only with their lives. But by the persuasion of one of their converted chiefs, who had been taken prisoner, and had embraced the Christian faith, they were induced to lay aside all thoughts of resistance, and to submit to the Spaniards, upon condition of their being protected in the possession of their liberties and effects, and that especial regard should be paid to the rank and dignity of their nobles. This event happened on the 29th of April 1483, which day is now annually held as a great festival throughout the island of Grand Canary, where the standard which was then in the Spanish camp, and which is deposited in the church of St Anna, is carried in solemn procession. On the 20th of February 1487, this island was incorporated into the crown of Castile, with the title of kingdom, and declared free from certain duties. In the same year it was erected into a bishopric by Pope Innocent VIII.; and its patronage was given to the king of Spain, and his successors for ever. In 1499, a body of laws and charters was sent over to Grand Canary for the government of its inhabitants; and, in 1515, the Emperor Charles V. bestowed on Palmas, the capital of the island, the title of noble and royal city of Palmas.

After the reduction of Grand Canary, many of the Spaniards preferring an active military life to one of ease and retirement, which they might have quietly enjoyed in that island, looked to Palma and Teneriffe as the scenes of farther conquest. Among these was Captain Alonzo de Lugo, who had served with much reputation in the Canarian war, and who, by his interest at court, procured a grant of the conquest of the two islands from their Catholic Majesties. With a fleet properly equipped, and well supplied with men, ammunition, &c. necessary for the undertaking, he sailed for Palma, and on the 29th of September 1490, landed at the port of Tassacorta, on the west side of the island. Having fixed and strongly fortified his camp, and also built a chapel, which he dedicated to St Michael, he proceeded to the subjugation of the inhabitants. This, in part, he easily effected, especially with those of the south west quarter of the island, whom he reduced, not by force of arms, but by promises and presents. The natives, however, in the north-east side, refused all his offers. They had formerly suffered very injurious treatment from the Spaniards of Ferro, and, suspecting their present intruders of the like intentions, no promises could induce them to submit. They retired to one of their strong holds among the mountains, which the Spaniards called the cauldron, from its resemblance to that vessel, and here they defied all the skill and valour of their adversaries. But finding that the Spaniards had come to settle in the island, and were determined upon their reduction, they at last agreed, that if the Spaniards would retire to the foot of the mountain, they would come next day and make their submission. Alonzo de Lugo complied, but at the same time suspecting that it was merely a stratagem to dislodge him from his present position, he left an ambush to cut off their retreat, in case they should follow him, and afterwards wish to return to the cauldron. When the natives appeared, according to the agreement, they found the Spaniards armed, and in order of battle, and, apprehensive of some treacherous design, they refused to proceed. But Tanause, their chief, assured them, that as he had Alonzo's promise, they had nothing to fear. The faith of the Spaniard, however, was of too accommodating a nature to allow the present opportunity to escape, and not being yet assured of their real intentions, fell upon them with all his forces, when a very bloody skirmish ensued, which ended with the death or captivity of all the natives. Tanause, who was among the prisoners, was sent over, with several of the other chiefs, to Spain, along with the agreeable tidings of the conquest. He bitterly complained against Alonzo for his breach of promise, and took it so much to heart, together with his being sent out of the island, that he obstinately refused all manner of nourishment, and starved himself to death.

The conquest of Teneriffe was not so easily accomplished, and the reverses which Alonzo met with in that island were justly merited by his perfidy at Palma. He landed at the port of Santa Cruz, on the 3d May 1493, and no sooner had he encamped in the plain of Laguna, than he was visited in a friendly manner by several of the petty kings of the island, who then happened to be at war with Ventomo king of Taora. Ventomo was the most powerful and independent prince of Teneriffe, and when invited to a conference, and requested by Alonzo to embrace Christianity, and become a vassal of the king of Spain, he replied: that as to embracing Christianity, he knew not what he meant; and as to his becoming a vassal of the king of Spain, he never would, for as he was born free, and had all his lifetime continued so, so he intended to die. Alonzo, relying upon the strength and valour of his forces, and the friendship of the other chiefs, who seem to have remained quiet spectators of the contest, advanced fearlessly into the country. Having made a great booty of cattle, he was returning back, but was intercepted in a narrow defile by the brother of Ventomo, at the head of 300 Guanches, who fell upon the Spaniards with such fury, that these being unable, from the nature of the place, to avail themselves of their cavalry and superiority of numbers, were completely routed, and pursued with dreadful slaughter. When Ventomo came up with fresh troops, he found his brother resting himself upon a stone by the wayside, being much fatigued, and reprimanding him severely for not joining in the pursuit, the other coolly replied; "I have done my part in vanquishing the enemy, now the butchers are doing theirs in killing them." In this battle the greatest part of the Spanish army perished, and Alonzo himself narrowly escaped. This was the severest defeat the Spaniards had ever experienced in these islands, and the place where the action was fought is, to this day, called La Mantansa de Centejo, "the slaughter of Centejo." Alonzo, quite dispirited by this disaster, re-embarked the remains of his troops, and returned to Grand Canary. But having received considerable reinforcements from Spain and Lancerota, and after recruiting his own forces, he found himself at the head of 1000 foot and 70 horse, completely armed. Not discouraged by his late failure, he again proceeded to Teneriffe, but found the whole island now united against him. He, however, advanced to the plain of Laguna, avoiding in his march all ambuscades and difficult passes. The natives, astonished at his speedy return, after such a defeat, with so large an armament, and finding, from the good order and precautions with which he advanced, that, in their several encounters, they could make no impression upon the Spaniards, thought seriously of coming to some agreement. Having requested a conference, they demanded of the general, why he invaded their island in that hostile manner, without any provocation, disturbing the repose of the inhabitants, plundering them of their cattle, and carrying the people into captivity? To this Alonzo replied, that he had no other design than to make them become Christians, which if they consented to do, they should remain in quiet possession of their land and effects. To this proposal the Guanches, after some deliberation, agreed; and all who were then present were immediately baptised. Having thus peaceably secured the submission of the island, Alonzo founded a hermitage on the spot where the treaty was concluded, which he called Nuestra Senora de la Victoria, our Lady of Victory; and after settling the government on a regular plan, he laid the foundation of the city of Laguna, on the 25th of July 1495. This conquest completed the reduction of the Canaries, which were immediately annexed to the crown of Spain, and they still constitute a part of the dominions of that kingdom.

The Canary Islands, before they were subdued by Europeans, were divided into several small states, each governed by its respective Guanarteme or prince, and separated from one another by a wall of loose stones, frequently crossing from sea to sea. A whole island was sometimes under the dominion of one prince, as was the case with Ferro, and also with Teneriffe, a few years before its conquest; though at that time it was divided into nine different kingdoms. The royal dignity in this island was elective; and the king was always obliged to marry a person of his own rank. If such a one, however, could not be found, he took his own sister, not being permitted to debase his family by a mixture of plebeian blood. Besides these chiefs, they had also in Grand Canary a race of nobility, who were distinguished from the vulgar by the peculiar cut of their hair and beards. This rank, however, was not altogether hereditary; for, before the son of a nobleman could be considered as noble, he must have been formally declared so, by the Faycag, an officer of great rank, and next in dignity to the Guanarteme, whose business it was to regulate the ceremonies of religion, and to act as judge in civil affairs. The ceremony of conferring this dignity was performed with great solemnity. The young man claiming the honour of nobility was presented before the assembled nobles, and inhabitants of the town or district to which he belonged. These were required to declare upon oath, whether they had ever seen the youth demean himself by submitting to any mean occupation; whether he had ever forcibly, or by stealth, taken away any of his neighbours' cattle; and whether he was in any way discourteous, ill-tongued, or guilty of any indecent behaviour. If even one of these charges were brought against him by any of the assembly, and sufficiently substantiated, the Faycag shaved his head, and dismissed him with disgrace, by which he was rendered incapable of nobility, and remained ever after a plebeian. If, on the contrary, however, he was declared free from every such imputation, the Faycag cut his hair in a round form, and so short as not to hang beneath his ears; then putting into his hand a staff or pole, called *magade*, declared him noble. In Teneriffe, the inhabitants were divided into three classes,—the nobles, the yeomen, and the peasants. From the variety of interests in these islands, frequent disputes arose concerning their flocks and pastures, and the boundaries of their respective districts. These disputes often ended in wars, which overspread the face of the country with blood and carnage. Their principal weapons were wooden spears and darts, sharpened at the point, and hardened in the fire. They also threw stones with great force and dexterity, either from the hand or a sling; and sometimes used huge clubs, which, in Grand Canary, they called *modagas*. In Teneriffe, when an enemy approached, they alarmed the country by kindling a fire, or by whistling, which was repeated from one to another, and was heard at a most incredible distance. The women often attended their husbands to the field of battle, and were employed in taking care of the wounded, and carrying off the dead, which they interred in caves. By these wars, whole districts were depopulated; and some of the states, in a short time, experienced many changes of masters. Duels were very common in these islands; and it was upon such occasions, in particular, that they were most anxious to display their strength and valour. Public places were set apart for this purpose; and the combatants were surrounded by their friends and relations, not to assist them, but to be quiet spectators of their gallantry and behaviour. These disputes were generally decided on public festivals or rejoicings, in the midst of a great concourse of people. The battle was begun by each of them throwing three round stones, which they in general dexterously avoided, by the writhing of their bodies; then, arming themselves with cudgels in their right hand, and sharp flints in their left, they cut and beat one another until the Gayres or nobles cried out "gama!" *enough!*—when they immediately retired, and ever after remained good friends. Though much addicted to war, this people were of a humane, cheerful, and friendly disposition, of which the Spaniards sometimes took advantage; and, during their reduction, often gained more by conciliatory measures than by force. They were faithful in all their dealings; and it was owing to the failure of the Europeans in this respect, that the Canarians resisted so long every offer of accommodation.

Excepting the inhabitants of Lancerota and Forte Ventura, who were more gigantic and better made than those of the other islands, the natives were in general of a middle stature, but extremely athletic, and particularly skilful in the exercise of wrestling. A remarkable feat of this kind is related of Adargoma, the Canarian chief, who was taken prisoner by the Spaniards at the battle of Guiniguada. When at Seville, a peasant of La Mancha, famous for his strength, having heard of the Canarian as an extraordinary wrestler, challenged him to a trial of skill. Adargoma accepted the challenge, but proposed that they should first drink together; and, taking a glass of wine, he said to the Spaniard: "Brother, if you can, with both your hands, prevent my carrying this wine to my mouth, or cause me to spill one drop, then I will wrestle with you; but if you are unable to do this, I would advise you to return home." He then drunk off the wine, in spite of all the other's efforts to prevent him, which so astonished the peasant, that he prudently took his advice and retired. The common dress throughout the Canaries was a cloak made of sheep or goat skins, to which the women added a petticoat, reaching down to the knees, and a cap or bonnet of the same materials, which they sometimes adorned with feathers. Their shoes were formed of raw hides, with the hairy side out. The Canarians had also a light coat, the stuff of which was manufactured from a sort of rush, which being beat, became soft like flax. Some of their garments were curiously sewed with thin thongs of leather as fine as common thread, and painted with various kinds of dyes, which they extracted from the roots of trees and herbs. Their houses were all built of stone, but without cement or mortar of any kind, and sometimes so neat and regular, that many of the villages made a very good appearance. In Grand Canary they laid wooden rafters or beams along the top, which they covered with earth; but in Ferro, where the houses were of a circular form, and so large that they sometimes contained twenty families, the roof was formed of branches of trees and fern. Their furniture consisted of goat skins, which were their only beds; and baskets and mats very ingeniously wrought. They had also earthen vessels dried in the sun, which they used in cooking, and for holding their victuals. Goat's flesh and mutton, either roasted or boiled, constituted their principal food. These, however, they ate alone, without any addition of bread or roots. They used also barley meal roasted and dressed with butter, which they called *goffio:* and in some of the islands, they had a kind of bread made of fern roots, which, with milk and butter, composed the chief part of their diet. In Grand Canary, no person was allowed to kill his own cattle. This office was confined entirely to the butchers, who, from their employment, were held in general abhorrence; and this trade was accounted so ignominious, that it was unlawful for a butcher to keep company with any but those of his own profession. He was not even permitted to enter the house, or to touch any thing that belonged to the rest of the inhabitants, who were in their turn prohibited from visiting any of the public shambles. The only compensation for this degraded trade was, that the natives were obliged to supply the butchers with every thing they had occasion for. This aversion for an employment, which, from its very nature, must deaden in some measure the feelings of kindness and humanity of those who exercise it, shew a degree of refinement in this people which is seldom to be found even among the most civilized nations. Their delicacy with regard to the female sex is equally worthy of admiration. The least indecent word or action was severely punished, and it was a prevailing custom at Teneriffe, that if a man by chance met a woman alone on the road, or in a solitary place, he was not to speak to, or even to look at her, but to turn out of the way until she was past. Contrary to what some authors have affirmed, these islanders never had more than one wife at a time, though in their marriages, they paid no regard to consanguinity, except that of a mother or sister. In Grand Canary, when parents were inclined to marry their daughter, they confined her for thirty days; and fed her with large quantities of milk and goffio, in order to fatten her; for they imagined that lean women were incapable of conceiving children. They could, however, put away their wives when they pleased; but, in such cases, their children were, by this means, rendered illegitimate, and incapable of inheriting their father's effects. In all diseases, their prevailing cures were bleeding, burning, and anointing. When any one fell sick, they rubbed his body with sheep's marrow and butter, and then covered him well up, to keep him warm, and promote perspiration; but, when troubled with acute pains, they drew blood, by scarifying the affected part with sharp stones. When they received any cut or wound, they burned it with fire, and then anointed it with goat's butter. They also employed herbs; and, in Teneriffe, they had a kind of medicine prepared from *mocanes*, which they used in fluxes and pleurisies, the most common diseases of the island. When any of the nobles died, they embalmed the body, and shut it up in the cave set apart for the family burying-place. Some of them were put into chests, and afterwards deposited in stone sepulchres. The office of embalming belonged only to particular persons; and each sex performed it for their own dead. In Teneriffe, the king could only be buried in the cave of his ancestors; and the corpses were so arranged as to be known again. About the middle of last century, two of these embalmed bodies, which were taken out of a cave, were found perfectly entire, and as light as cork. The hair, teeth, and garments, were quite sound and fresh, and without any disagreeable smell.

Some of these islands were remarkable for their good government and strict administration of justice. In Grand Canary, the punishment immediately followed conviction. If the delinquent was charged with a capital crime, his head was placed upon a flat stone, when the executioner, with another, dashed out his brains. In all other cases, they used the *lex talionis*. In Ferro, no crimes were punished but murder and theft. The murderer was put to death in the same way as he had killed the deceased: and the thief, for the first offence, lost one eye, and for the second the other, that he might not see to steal any more. In Lancerota and Forte Ventura, they had a law, that, in cases of quarrel, if a man entered openly by the door into his enemy's house, and killed him, or did him harm, he was not liable to be punished; but if he climbed over the wall, or came upon him unawares, he was condemned to suffer death; and the method of execution was the same as in Grand Canary. In Palma, as in Sparta, theft was considered as a virtue; for he was esteemed the cleverest fellow who could steal with such address as not to be discovered; and, if detected in the act, he was merely obliged to restore the plunder. The common punishment in Teneriffe was cudgelling, which was generally executed in the presence of the king and elders. In cases of murder, the criminal was punished with banishment and the confiscation of property, which was bestowed upon the relations of the deceased; but death was never inflicted for any crime, as they had a belief that it belonged to God alone to take away that life which he gave.

Some authors, following the account of the Nubian geographer, have represented the inhabitants of the Canaries as gross idolaters. This geographer relates, "that in each of the Fortunate islands is to be seen a pillar raised of stone, of an hundred cubits length, each pillar supporting a brazen image, with its hand lifted up and pointing backwards." Pyramids of this description, though without the image, were found in the island of Palma; and in one district, there is a long narrow rock upwards of an hundred fathoms high, where the natives used to worship their god Idafe, whose name the rock itself still retains. It would appear, however, that the religion of many of these islands was pure theism. They adored only one god, whom they denominated by various titles, as the Great,[*] the Sublime,[†] the Possessor of the World,[‡] the Sustainer of Heaven and Earth;[§] and the only worship which they offered, was the lifting up of their hand towards heaven in silent adoration. In Grand Canary and Lancerota they had houses of worship, but no images, or any representation of the Deity; and their sacrifices consisted in the pouring out offerings of goats' milk. The Canarians had also several convents, inhabited by religious women called Magadas, which were held sacred; and all criminals who fled thither, were protected from the officers of justice. In Ferro, however, they had two deities; one of them male, named Eraoranzan, who was worshipped by the men; the other female, called Moneyba, worshipped by the women. In seasons of great distress, occasioned by a long drought, or any other public calamity, it was an universal custom in these islands for the natives to assemble in certain places, set apart for the purpose, with their children and flocks, and, sitting in a circle on the ground, began to lament and make a mournful noise, their flocks bleeting also for want of food; for both men and beasts, on these occasions, were debarred all kind of sustenance. These fasts sometimes lasted three days and three nights. The wealth of these islanders consisted chiefly in their flocks and herds. Agriculture was little known among them; and practised only in its rudest form. They broke the ground with a wooden hoe, which had sometimes a goat's horn fixed to the end of it, and then threw in the seed. Barley was their principal grain; but they had also wheat, beans, and peas or vetches. In harvest, they reaped only the ears, which they threshed with sticks, or beat out with their feet, and then winnowed the corn with their hands. Their only fruits were *vicacorras*, mocanes, and wild dates.

Various opinions have been entertained concerning the first inhabitants of the Canary islands; but the most probable account is, that they were originally Lybians, who, upon the conquest of Barbary by the Arabs, fled thither, to avoid falling into the hands of their victorious enemies. The truth of this Mr Glas has attempted to prove, by a comparison between the language of South Barbary and that of the natives of the Canaries. The languages of all the islands, except Teneriffe, though different, had some affinity to each other, and were evidently branches of one original language; and their resemblance to the Shillha, and other dialects of the Lybian tongue, is a strong presumption, that they derived their origin from the same stock. The probability is also considerably strengthened by the similitude of customs. The principal dish of the Lybians, called *couscoussou*, was much the same with the goffio of the Canarians. They both poured hot butter into their wounds; and they both fattened their daughters with milk before they gave them in marriage. The language of Teneriffe, however, was perfectly different from that of the other islands; and, according to Mr Glas, it seemed to have some resemblance to the Peruvian, or some other of the American tongues.

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[*] Achuhuiaban.

[†] Aahuhucana.

[‡] Guararirari.

[§] Acheran.

Since the conquest of these islands, the language and customs of their inhabitants have been almost entirely lost in those of their conquerors. The natives have been so incorporated with the Spaniards and other Europeans, that they have become one people. They all use the Castilian language; and, in their dress, manners, and appearance, resemble their fellow subjects in the peninsula. Their complexions, however, are rather more swarthy; but they have good features, and fine large sparkling black eyes, which give a vivacity and dazzling lustre to the countenance. The higher classes are in general poor, yet extremely polite and well bred. They boast much of their birth, and claim their descent from some of the best families of Spain. The peasantry have also a considerable share of good manners; but still retain their aversion to certain professions, as butchers, tailors, millers, and porters. The poorest fisherman would think himself degraded, by exercising any of these employments, and would even refuse to sit at the same table with any one belonging to these trades. People of all ranks are rather of a romantic disposition, particularly in love affairs. All intercourse between the sexes are restrained within the strictest bounds of decency and decorum; and what even English women would consider as innocent freedoms, no virtuous woman in the Canaries would bear. Love-engagements are declared binding by law; and if a woman can prove, that a man has in the least instance endeavoured to win her affections, she can oblige him to marry her. It must be allowed, however, that unhappy marriages are more common here, than in those countries where innocent freedoms subsist between the sexes previous to their union, and where the lover has an opportunity of perceiving that his mistress is mortal, and partakes of human frailty. The diversions among the vulgar are, wrestling, cards, quoits, and throwing a ball through a ring; also, music and dancing, of which they are very fond. Each of the islands, and even every town and village, has some particular saint for its patron, whose day is celebrated as a festival, by a particular service in the church, and by a fair and rejoicings in the evenings. Every family of eminence, also, has its saint or patron, to whose honour an annual festival is held at great expense; and on such occasions, the gentry vie with one another in costly entertainments and splendour. All the inhabitants of these islands are rigid Catholics, and it is impossible for a person of a different persuasion to live among them. There is a house in every island belonging to the Inquisition, with its proper officers, whose duty it is to prevent all appearance of heresy or disrespect to the clergy. The bishop of the Canaries resides in the city of Palmas, in Grand Canary. He is a suffragan to the archbishop of Seville in Spain, and is treated with all the respect and homage due to a sovereign prince. The superiors of the different orders of friars and nuns live in the city of Laguna, in Teneriffe, and are accountable only to generals of their respective orders. The civil government is vested in the royal audience of Grand Canary, which is composed of three judges, a regent, and fiscal, who are generally natives of Spain, and always appointed by the king. Of this tribunal, the governor-general is president, though his usual residence is at Teneriffe. From the sentence of this court there is no appeal, except in cases of property, when appeals must be carried to Spain. The other magistrates in these islands are the corregidor, the tiniente, the alcalde major, and the alcalde. The corregidor is appointed by the king, and holds his office for five years; the others are nominated by the royal audience. The office of alcalde nearly resembles that of a justice of peace in England, and every town or village of any consequence has one.

From the appearance of the different strata which compose these islands, we may reasonably conclude, that they are of volcanic origin. A very great proportion of their surface is also covered with calcined rock, pumice stones, and black dust and ashes, which are evidently the remains of several successive eruptions. The craters of several volcanoes are still discernable in many of the islands; and also the channels made by the lava which flowed from them. The climate, however, is delightful, and exceedingly salubrious.

The rainy season continues here from the beginning of December until March, which they call winter, though it very seldom freezes; and snow is only to be seen on the tops of the mountains. During the summer, the sky is always serene, and the heat is very intense, particularly during the months of July, August, and September. The climate, however, in these islands is far from being uniform; for while in the cities upon the coast the air is hot, dry, and calm, the inhabitants of the mountainous districts experience fogs, wind, and even rain. From the centre of many of these islands being exceeding high, and full of lofty mountains, which tower so far above the clouds as to intercept the current of the winds, a calm generally prevails on the lea-side of the island, or a gentle breeze from the opposite quarter. These calms, or eddy winds, are extremely dangerous to small vessels approaching the islands; for, at the extremity of the smooth water, the waves break in all directions; and when a ship comes among them, she is shaken and beaten on all sides in such a manner, that it is almost impossible to withstand it. The calms on the leeward of Grand Canary extend 20 or 25 leagues into the ocean; those of Teneriffe 15; of Gomera 10; and of Palma 30.

The soil of these islands is very fertile, and produces all kinds of grain, fruits, and pulse, in great abundance; but the method of cultivation which is practised by the inhabitants tends very little to its improvement. The lands are here let, not for money, but for the half of the produce. The proprietor furnishes the seed, and other articles of the first necessity, also the cattle, which indeed belong to him, and which he can take back at the expiry of the lease. For these, he receives the half of the crop during the term of agreement, besides a *fanega* of wheat for every head of cattle. The peasants often rent the cattle without the land, merely to share the half of their increase. In these agreements the husbandman has no inducement to exertion. A moderate crop is all that he expects or desires; for a plentiful harvest can be of very little value to him, who is prevented, by the prohibitory measures of his government, from converting the overplus into wealth, or exchanging it for foreign commodities. The necessaries of life are all that he requires;

and his labour is confined to the production of these alone. Thus rendered indolent and improvident, he is never prepared against a season of scarcity; and is sometimes reduced, like his savage ancestors, to feed upon bread made from fern roots. It is, however, a fact, the truth of which is established by experience, that a scarcity of provisions in any country arises not so much from the sterility of the soil, as from the measures of government; and it need scarcely be remarked, that famine is more frequent in some of the rich and fertile districts of the south, where the exertions of industry are paralised by arbitrary regulations, than in many countries which possess an ungrateful soil, but which are ruled by a wiser and more liberal policy. Sugar was formerly made here in great abundance; and twelve sugar mills were employed in the manufacture of this article in Grand Canary alone. It has of late, however, very much fallen off; and the cotton plantations have also been greatly neglected. Besides these, olives, mulberries, and tobacco, might be cultivated here with great success. These islands produce plenty of honey, wax, and a kind of black gum or pitch called *bray*. All the islands furnish excellent wine, but the preference is in general given to those of Palma and Teneriffe. In good seasons, Teneriffe alone produces above 30,000 pipes, a third of which is Malmsey or Canary sack, which sells from 50 to 60 piastres a pipe. The rest is a dry hard wine, which sells for about half that price. When two or three years old, it can scarcely be distinguished from Madeira; but when allowed to stand for four years, it turns mellow and sweet, and resembles greatly the wine of Malaga in Spain. The cattle of the Canaries are, horses, oxen, goats, sheep, roebucks, and wild asses. They abound with several kinds of game, and poultry, also with singing birds, particularly the Canary bird, so well known throughout Europe; and their shores are well stocked with fish, especially sturgeons and mackarel, which are a great source of nourishment to the poor inhabitants.

Teneriffe is the great centre of European commerce in these islands. Some ships go to Grand Canary and Palma, but their number is very inconsiderable; and this branch of trade is chiefly in the hands of the English. The principal exports to Europe and the British colonies in America, are wines, brandy, fruits, orchilla-weed, and commodities which they receive from the Spanish West Indies. From the British islands they receive various kinds of woollen cloths, hats, stockings, hardware, &c. also wheat, when there is a scarcity in the island, and beef, pork, butter, candles, and salt herring; from the north of Europe, linens, cordage, gun-powder, bar iron, &c.; from the Mediterranean, cottons, silks, velvets, salt, oil, bass cordage, and innumerable small articles, either for home consumption, or for exportation to the Spanish West Indies; from North America, deal boards, pipe staves, *bacallao* or dried cod, hams, bees-wax, rice, &c. All these goods, imported into the Canaries, or exported from them, pay a duty of 7 per cent. on the rated value. The commerce which these islands carry on with the Spanish settlements in the West Indies, is under particular regulations and restrictions. No foreign bottoms are permitted to be employed in this trade, nor are vessels allowed to be fitted out from any of the islands except Grand Canary, Teneriffe, and Palma. This trade is confined to their own produce, of which they annually export nearly 2000 tons; but they also find opportunities of smuggling into the country immense quantities of European commodities. Besides this foreign commerce, the Canaries carry on a considerable trade with each other. The island of Teneriffe is the principal staple of all West India and European commodities, which it distributes among the other islands; and receives in exchange, from Grand Canary provisions of all sorts, coarse woollen blankets, raw and wrought silk, flags, filtering stones, and some salt, &c.; from Palma, almonds, sugar, sweetmeats, boards, pitch, and raw silk: from Gomera and Ferro, raw silk, brandy, and cattle; from Lancerota and Forte Ventura, a great quantity of corn, cattle, and fowls, also some salt and dried fish; and from all of them orchilla weed.

The principal manufactures of these islands are, taffeties, coarse linens, gauze, quilts, knit silk hose, and silk garters; and in order to encourage their silk manufacture, the exportation of raw silk is strictly prohibited. Coarse woollen cloths, and white blankets, are also manufactured in many of the islands from the produce of their own sheep. In all the villages, the women only are employed in weaving, or as tailors, and it is only in large towns that the men exercise those trades. The inhabitants of the Canaries employ a considerable number of vessels in the fishery on the coast of Barbary, which, if properly encouraged by the Spaniards, might be rendered a source of great convenience and profit to those islands. But the trade is clogged with foolish and unreasonable duties; and the price is impolitically regulated by the magistrates. This fishery extends along the coast about six hundred miles, from Cape Blanco on the south, to the southern extremity of Mount Atlas on the north. The vessels employed in this trade are from fifteen to fifty tons burthen, the smallest carrying fifteen men, and the largest thirty; and the general place of rendezvous is at Porto de Luz, in the island of Grand Canary. They make from eight to ten voyages in the year. The bulk of their cargoes consist of *samas* or bream; but they also catch a great quantity of tassarte, cod, anhoua, carbino, and other kinds of fish. The tassarte tastes like a very large and fat mackerel, and when dried cannot be distinguished from dried salmon; and the cod that is caught on this coast are considered as preferable to those of Newfoundland. "Although this fishery," says Mr Glas, "is capable of the greatest improvement, yet the English have no reason to be apprehensive of the Spaniards ever being able to bring it to any degree of perfection, so as to rival them in the Spanish or Italian markets: the power of the clergy in Spain is a better security to the English against such an event, than if a fleet of a hundred sail of the line were stationed on the coast of Barbary, to obstruct the Spanish fishery."

The situation of the Canary islands, the salubrity of their climate, the fertility of the soil, and the quality of their productions, all conspire to render them the most valuable of the Spanish colonies; and even preferable to those boasted possessions of America, which fill their galleons with treasure. If they were inhabited by an active and industrious people, and placed under a government where agriculture and commerce were encouraged and protected, they would soon rise to deserve the distinguished appellation of the *Fortunate Isles*. According to M. Humboldt, the population of these islands is estimated at 180,000 persons, and their revenue at 240,000 piastres; but the expences of their administration are such, that they require an annual remittance from Spain. See *Histoire de la premiere de couverte, et conquete des Canaries*, par F. Pierre Bouthier Religieux de S. François, et

Jean le Verrier Prestre, Paris 1630, 8vo.; Glas's *Description of the Canary Islands;* Viera's *History of the Canaries;* Bory de St Vincent *Essai sur les Iles Fortunées;* and *Memoires de L'Institut National a Paris*, tom. i. p. 250. (*p*)

CANARY, Grand, one of the Canary islands, which gives the general appellation to the groupe, lies between the islands of Teneriffe and Forte Ventura, and about 100 miles north-west from Cape Bojador on the African coast. It received the epithet of *Grand* from John de Betancour, not on account of its size, but because of the strength, courage, and number of its inhabitants, who baffled all his attempts to subdue them. But from whence it derived the name of Canary has never yet been determined. According to Pliny, it was on account of its abounding with dogs of a very large size, two of which were presented to Juba, king of Mauritania. But if such animals ever did exist in this island, they were completely extinct when it was first visited by Europeans. Some modern authors derive it from a species of fruit very abundant here, called by the Latins, *uva canina*, dog grapes; or from a herb named *canaria*, which dogs eat in the spring to cause them to vomit. Others suppose, and with more reason, that it received its name from its first inhabitants, who were probably a tribe of Africans, as Pliny mentions a people called Canarii, who dwelt beyond Mount Atlas, a part of Africa which lies adjacent to the Canary islands. But however that may be, it is rather strange, that we have never been informed under what name it went among the natives.

At a distance, this island has the appearance of a single mountain rising gradually from the circumference to the centre. It is about fourteen leagues in length, nine in breadth, and thirty-five in circumference. Though Grand Canary is high and mountainous, yet near the sea coast there are many plains, and more level ground than in any of the neighbouring islands. On the north-east end is a small peninsula about two leagues in circumference, which is joined to the main land by a narrow isthmus two miles long, and about a quarter broad. On the south side of this isthmus is a spacious bay called Porto de Luz, which is a capital road for shipping of any burthen, and where the water at the landing place is generally so smooth, that a boat may lie broadside to the shore without danger. About a league to the west is the city of Palmas, the capital, and residence of the royal audience or sovereign council of the Canaries. It is a place of no strength, but of considerable extent, and contains several fine buildings, particularly the cathedral of St Anne. The houses, though only one story high, are in general elegantly built and flat at the top. It has four convents; and its population is estimated at about 12,000. The other ports are Gando and Gaete, and, excepting at these places, the whole coast is inaccessible to boats or vessels, on account of the high surf which is continually breaking upon it. Its other towns are Galdar, Telde, Tirachana, and Luz.

This island possesses one of the finest climates in the world. The heavens are seldom overcast, but are almost continually serene, and free from storms and thunder. No where in the same latitude are the heats of summer so temperate, and no where do the natives enjoy such health and longevity. The only disagreeable weather which they experience, is when they are visited by a south-east wind from the great desert of Africa. It is hot, dry, and stifling, and does great damage to the fruits of the earth by its pernicious quality, and is generally attended with immense clouds of locusts, which devour every green herb upon which they alight. This wind, however, blows very rarely, and never lasts long.

The soil of this island, though light and sandy, is covered with a rich mould, and yields two harvests in the year. It is well watered, and suited for every species of agriculture, and is very productive in all kinds of trees, fruits, and herbs. The pine, palm, wild olive, laurel, poplar, elder, bressos, drage tree, terra nuepa or *lignum Rhodium*, aloe, Indian fig, tubayba, euphorbium, tarrahala, and many others, grow spontaneously and without cultivation. It also abounds with almonds, walnuts, chesnuts, apples, pears, peaches, apricots, cherries, plums, mulberries, figs, bananas, dates, oranges, lemons, citrons, limes, pomegranates, and all the American and European fruits, except the anana, or pine-apple, which is not to be found in any of the Canaries. The fertile districts of this island, however, bear no proportion to the stony, rocky, and barren ground, which covers almost six-sevenths of its surface. Yet they have plenty of excellent wheat, barley, and maize, melons of different sorts, potatoes, yams, pompions, the best onions in the world, and many other kinds of roots all good of their kind; and the husbandman is amply repaid for the labour of cultivation. But the spirit of industry is completely checked by the imprudent conduct of the government, which prohibits the exportation of provisions in a plentiful season, and fixes a price upon them in the island. Many lands are, on this account, allowed to lie waste, which, had the inhabitants more liberty and security for their property, would, by a little labour and expence, be soon rendered abundantly fruitful, as they have the utmost facility of watering them, by turning the course of the many rivulets with which the island abounds. "The most fertile part of Canary," says Mr Glas, "is the mountain of Doramas, situated about two leagues from the city of Palmas. It is shaded by groves of different kinds of fragrant trees, whose lofty boughs are so thickly interwoven as to exclude the rays of the sun. The rills that water those shady groves, the whispering of the breeze among the trees, and the melody of the Canary birds, form a most delightful concert. When a person is in one of these enchanting solitudes, he cannot fail of calling to remembrance, the fine things the ancients have written of the Fortunate Islands."

The sugar plantations, which were formerly numerous and extensive in this island, and which employed fourteen large manufactories, have now, in a great measure, given place to the cultivation of the vine. The wines and brandies of Grand Canary have always been in great demand in the Spanish West Indies, and the inhabitants find it more profitable to exchange these for sugar than to raise it in their own country. The wine of Grand Canary, however, though good, has not such a body as that of Teneriffe, and is consequently not so fit for exportation. The animals of Grand Canary are camels, horses, asses, mules, bullocks, a few sheep, &c. also turkeys, geese, fowls, ducks, partridges, and Canary birds. Population 40,000. See Canary Isles, and the references subjoined to that article. (*p*)

CANCER. See Surgery.

CANCER. See Crustacea.

CANCER, or the Crab, in astronomy, is the name of one of the twelve signs of the zodiac. The particular arrangement of the stars in this constellation is supposed by some to have been the origin of the name, from their fancied resemblance to a crab; while others ascribe it to the analogy between the retrograde motion of this animal, and the motion of the sun which begins to recede from the earth when it enters the sign Cancer. In Ptolemy's catalogue this constellation contains 29 stars, in Tycho's 15, in Bayer's and Hevelius's 29, in Flamstead's 83, and in the catalogue which we have given in the article ASTRONOMY, it contains 87 stars. (*w*)

CANDAHAR, or KANDAKAR, the capital of a country of Asia of the same name, situated between Persia and Hindostan, and supposed to be a part of the *Paropamisus* of the ancients. The city of Candahar, which is both populous and flourishing, is built of a square form, and is comprehended within an ordinary fortification of about three miles in circumference. From its favourable situation on the great road which connects India with Persia and Tartary, this city has long been a distinguished mart of trade. Many Hindoo families, principally of the Moultan and the Rajepoot districts, have established themselves here. By their industry and mercantile knowledge, they have greatly increased the trade and opulence of Candahar; and the extensive range of shops which they occupy, and the ease and contentment expressed in their deportment, is a sufficient testimony of the liberty and protection which they enjoy. This city is likewise frequented by the Turcoman merchants of Bucharia and Samarkand, who carry away into their own country a great quantity of the indigo with which Candahar is annually supplied from the various parts of upper India. Provisions are here much cheaper than in most places on the west side of the Indus, and the supply is also more abundant. Candahar stands in an extensive plain, intersected with numerous streams, and covered with fruit gardens and cultivated ground, which produces grapes and melons of the finest flavour. This plain is interspersed with hills near the site of the old fortress, but they are moderately high, and do not form a barrier of difficult access. This fortress, which is about two or three miles north of Candahar, stands on the summit of a rocky hill of moderate height, but abrupt elevation. It was destroyed by Nadir Shah, who founded a new city called Nadirabad. This city was completed by Ahmed, who gave it the name of New Candahar, and intended it for the capital of Afghanistan. The road is here carried over a stony ascent of easy access, and is sheltered on each side with scattered hills and wide intervals of level land. On the road from Ghizni to Candahar, the general aspect of the country is barren, and the supply of wood and water is scanty. From this scarcity of water, the buildings are constructed, as in Cabul, of bricks burnt in the sun, and are covered in with a flat arched roof of the same materials. The climate of Candahar is considerably temperate, and neither equals the heat of India, nor the cold of Ghizni.

A son of Timur Shah governs this city and a tract of the adjacent country, which is said to bring in an annual revenue of eighteen lacs of rupees. East Long. 65° 33′, North Lat. 33°. See Forster's *Journey from Bengal to England*, vol. ii. Lett. xiv. p. 115; and Decouverte *de l'Empire du Candahar*, Paris 1730, 12mo. (*o*)

CANDIA, the ancient CRETE, a rich and extensive island in the Mediterranean Sea, lies between 23½ and 26½ degrees E. Long., and forms as it were a base to the Grecian Archipelago. Its length from its most western coast to Cape Samonium on the east is about sixty leagues; and it is nearly fifteen at its greatest breadth, from Cape Sassoso on the north to Cape Matala on the south. A chain of mountains, called the White Mountains, or the mountains of Sphachia, traverses the greatest part of the island. During half the year it is covered with snow, great quantities of which are piled up by the inhabitants in deep vales, exposed to the north, where it condenses and hardens, and is then used for cooling their liquors in summer. From these mountains flow numberless streams, which, during winter, are swelled into torrents by the rains, and, in the spring, by the melting of the snow, and rushing with dreadful impetuosity down the steep declivities, do not stop till they lose themselves in the ocean. Many of them, however, are completely dried up during the summer; and the water with which the inhabitants then refresh their lands is drawn from the springs that issue from the bottom of the hills. The coast of Candia is indented with numerous harbours and roadsteads, which afford excellent and safe anchorages. The principal of these are, Grabusa on the west; the bay of Suda on the north; and Paleo Castro on the east. On the south, however, there are few places where a ship can ride with safety.

This island enjoys a most delightful climate, equally removed from excessive heat and violent cold. In summer, the rays of the sun are constantly tempered by refreshing winds from the sea; and during the short period of winter, which begins with December, and ends with January, snow never falls on the low grounds, nor is the temperature ever so low as to require artificial warmth. During this season the rains are frequent, but of short duration; and though the sky is sometimes obscured with clouds, and the north wind blows violently, yet the sun appears almost immediately after the rain, and the atmosphere is often clear and serene. Rain never falls in summer, either in Candia, or in the islands of the Ægean Sea. Vegetation is supported by the copious dews which fall during the night, and which sufficiently refresh such plants as are indigenous to the climate; but all others must be watered, in order to be successfully cultivated. Though Candia is situated under the 35th degree of latitude, yet, in the course of a year's observations, Mr Savary found, that from the month of March to the beginning of November, the thermometer never varied more than from twenty to twenty-seven degrees above the freezing point. But what conduces chiefly to the salubrity of Candia, is the complete absence of those noxious vapours which rise from marshy grounds, and the abundance of salutary plants. The waters never stand here in a state of stagnation; and scarcely is a morass to be found in the island. "The mountains and hills," says M. Savary, "are overspread with various kinds of thyme, and with a multitude of odoriferous and balsamic plants. The rivulets which flow down the vallies are overhung with myrtles and laurel roses. Clumps of orange, citron, and almond trees are plentifully scattered over the fields. The gardens are adorned with tufts of Arabian jasmine. In spring, they are bestrewed with beds of violets. Some extensive plains are arrayed in saffron. The cavities of the rocks, are fringed with sweet smelling dittany. In a word, from the hills, the vales, and the plains, on all hands, there arise clouds of exquisite perfumes, which embalm the air, and render it a luxury to breathe it." This climate has been famous from the remotest antiquity; and Hippocrates, the father of physic, considered it the best restorer of health to his debilitated patients, whom he sent hither to breathe an atmosphere impregnated with such delightful emanations. Under this genial sky the Turks have acquired a taller stature, a more robust make, and a more majestic step, than their countrymen on the continent; and it has been matter of surprise, that the natives, who enjoy the same blessings of nature, should have degenerated both in form and beauty. But the cause may be found in the yoke of that cruel slavery with which they are oppressed, and which has a tendency to degrade the body as well as the mind. They drag out their days in fear and anxiety, and are sometimes hurried by despair to put a violent end to their existence. Their countenances are disfigured with the marks of servility and meanness; and the high-spirited Cretans, once the jealous guardians of liberty and the arts, are now converted into cowardly, abject, and indolent Candians.

With the exception of the leprosy, diseases in this country are very rare. The victims of this loathsome disorder are driven from society, and prohibited from all communication with healthy persons.—They are generally confined to small cottages by the high-way, where they live upon the produce of a little garden, and the alms of passengers.

The salubrity of the climate is equalled by the fertility of the soil, which is capable of producing, in the richest profusion, whatever can delight the senses, or gratify the appetite. Among its spontaneous productions, besides innumerable fragrant flowers and shrubs of the most brilliant colours and dazzling variety, are myrtles, oleanders, walnuts, figs, pomegranates, apricots, almonds, lemons, citrons, oranges, olives, grapes, melons, and cucumbers. The grapes grow here to a very large size, and afford excellent wine, which still preserves its ancient reputation, though it is not made in such quantities as formerly;—the inhabitants of many of the districts preferring to carry their grapes to town, or to dry them for trade. Homer praises the wine of Crete as the best in the world; and Jupiter drank no other nectar during his stay in this island. All Candian wines, however, are of a fiery quality, and apt to fly quickly to the head, and to injure the nervous system.

At the foot of Mount Ida, and on the hills in the vicinity of Canea, grows a species of rock rose,[*] which yields *ladanum*, or, according to the ancient Greeks, *ledon*, a resinous substance used for perfumes, and the preparation of certain drugs. It is gathered from the leaves of the plant in the hottest time of the year, and during the greatest heat of the day. Great quantities of it are consumed in the East; and it is a considerable source of employment and profit to the peasants of Candia. Forests of pines, cedars, and firs, crown the summits, and cover the declivities of the mountains; and afford an inexhaustible source of materials for ship-building. The coasts abound with fish. The plains are well stocked with plenty of game, particularly red partridges and golden plovers; and the groves and gardens are filled with a variety of singing birds, among which are the linnet, the nightingale, the petty-chap, the goldfinch, the bull-finch, the lark, and the thrush. This last mentioned bird is taken in immense quantities, by the peasants, in the winter season, and carried to market. But the most melodious and valuable is the solitary black-bird,[†] which inhabits the summits of the mountains, and fills the desert with its music. It is called by the Greeks, *petro-cockiso*, "bird of the rocks;" and by the Turks, *kajaboutbowl*, "nightingale of the rock." It is in great request throughout Turkey, for its charming melody, and is seldom bought for less than a hundred dollars.

But in this rich and delightful country, where the soil requires very little labour from the hand of the husbandman, to produce in profusion the necessaries, and even luxuries of life, the Candian cannot, or dare not, appreciate the blessings and advantages which nature has so liberally scattered around him. Oppressed by his tyrannical masters—exposed to insult, to outrage, and even to robbery, from every janizary, he feels no inclination to increase, by labour, a produce which he would soon have the mortification of seeing pass into the hands of those whom he has so much reason to hate. Industry, of consequence, is almost extinct in the Greek villages subject to the Turkish agas. The fields which their forefathers cultivated and adorned, when under the mild government of the Venetians, are now running to waste. The soil is washed away by the rains; the olive-tree is allowed to perish, and the vine to disappear; and this unfortunate and degraded people do not think of repairing the damages which time has already occasioned, or of preventing future desolations. It is only the calls of hunger, or the payment of their taxes, that can incite them to the least exertion; and they sow their lands, and gather their olives, with the cheerless prospect, that a part of the produce must be devoted to their oppressors. The least appearance of wealth, or even of comfort, will immediately draw upon them new exactions; and they are compelled carefully to conceal whatever is not absolutely necessary for their daily subsistence. Their very clothes must have the appearance of poverty; and when those are renewed, they must be of the coarsest stuff, and plainest colours, otherwise they would run the risk of being deprived of them by the Turks. In the Turkish villages, agriculture and industry are equally neglected, though from very different causes. Most of the Turks in this island are enrolled among the janizaries; and though they may improve their property, without the dread of being despoiled of its produce, yet they prefer rather to depend upon their pay, and the extortions which, upon every opportunity, they wring from the industry of the Greeks. The only spot where cultivation is practised with any success, is on the mountains of Sphachia, which are inhabited by a hardy race, who, though oppressed with the same yoke as their brethren in the plains, have still preserved the energy of independence. Habituated to a simple and industrious life, the Sphachiot is a shepherd, a farmer, and an artisan. He requires no foreign supplies. He manufactures with his own hands the utensils and implements which he employs, and subsists upon the produce of his land, and of his flocks, enjoying, without molestation, the fruits of his labour. This people, from the first subjugation of the islands by the Romans, have disdained to mix with the nations that have successively occupied their country. Bred to the use of the bow from their youth, they are excellent soldiers; but bearing a mortal hatred to their present masters, several of them disgrace their courage and their skill, by robbing and murdering such Turkish travellers as they can waylay upon their mountains.

Were the least encouragement given to agriculture in this island, and were its advantages of soil and climate in any degree appreciated by the Turks, it would soon become the granary of the surrounding nations. But every species of improvement is here so disgraced and persecuted, and indolence and effeminacy have so destroyed all spirit of emulation and exertion, that the inhabitants of this fertile region are compelled to draw from other lands the means of their subsistence. Public granaries are erected near some of the principal towns, for containing the corn which is annually imported from Volo, Salonica, the Morea, Syria, and Egypt. The few places that are under cultivation, notwithstanding the deficiency of proper culture, produce most luxuriant crops. Wheat is sown after a single ploughing, and they content themselves with scattering the barley on the stubble, and then going over it with the plough. Whole fields are sown with lupins, which is a very common food with the Candians; but many useful plants, for which no soil or climate is more propitious than that of Candia, are almost completely neglected. The mulberry tree, which thrives wonderfully in this island, is very scarce; and most of their silk is brought from Syria. Flax is tolerably plentiful, but not sufficient for the wants of the inhabitants; and they draw their cotton from Smyrna, and the environs of Ephesus. Sesamum occupies some spots in the plains; but instead of extracting oil from its seed, the inhabitants use it only for mixing with their bread, to give it more flavour. Olive trees, however, grow here in great plenty; and their fruit is the chief article, both of the industry and commerce of the Candians. The annual produce of oil in this island, in a good season, is estimated at 200,000 milleroles, or 13,200,000 pints, Paris measure.

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[*] *Cistus ladaniferus*, Linn.

[†] *Le merle solitaire*, Buff.—*Turdus cyunus*, Linn.

The ancients asserted, that this happy region, the birth place of Jupiter, was freed by the indulgence of the gods, from every noxious animal. It is true, no quadrupeds of a ferocious temper belong to the island. Lions, tigers, bears, wolves, and foxes, are here unknown. The wild goat is the only inhabitant of the forest and the lofty mountains, and have nothing to fear but the ball of the hunter. Sheep overspread the hills and the plains, and graze in security, undisturbed by their ravenous enemies. Birds of prey, however, are to be found here, and also some venomous reptiles. Pliny,* indeed, mentions the *tarantula* as an inhabitant of Crete; and Belon enumerates three species of serpents which were known here,—the *ophis*, the *ochendra*, and the *ephloti*.† The tarantula is a kind of spider, about eight or ten inches in length, with a scaly skin. Its sting is mortal, and it generally lodges, during winter, in a deep hole, formed in the declivity of small hillocks; but, in the summer, it keeps in the air, and spins its web. M. Sonnini mentions another species of spider, equally dangerous with the tarantula, which is of the same size, but lives constantly in subterraneous retreats.

Among their domestic animals are, the horse, which is of the Barbary breed, but is much neglected, and illused, and has greatly degenerated, both in form and beauty, from the original stock. They are, however, strong and nice footed, and traverse, with great facility and safety, the roughest descents over steep and rocky mountains. The dog of Candia is a species of large grey-hound, which, for fleetness and agility, was formerly reckoned the best in Greece, after those of Sparta; but, since the Turks have made themselves masters of the country, this faithful friend of man is repulsed, beaten, and almost starved. Oxen are little used here, except in rural labour, and beef is scarce; hogs are also not very common, but lambs and kids are excellent and cheap, and turkeys and poultry are in great plenty, and sold at a moderate price. Notwithstanding, however, the abundance of every article of subsistence in this favoured country, the Greeks are obliged to live, through the whole year, on barley bread, salted olives, lupins, and wild plants;‡—the most valuable produce of their labour being reserved to discharge their taxes, and to pay the frequent and exorbitant extortions of their Agas.

This island is divided into three pachaliks, or governments; viz. Candia, Canea, and Retimo. In the first resides a pacha of three tails, who is *seraskier*, or commander-in-chief of all the forces in the island. He nominates to all military employments, and is intrusted with the inspection of the forts and arsenals. In Canea and Retimo are pachas of two tails, who, except in military concerns, are entirely independent of the pacha seraskier. The power of these officers is absolute within the bounds of their respective provinces. The justice of their decisions are never called in question; and their sentences are instantly carried into execution. As their chief object is to get rich as speedily as possible, they practise all the arts and cruelties of oppression to squeeze money from the unfortunate Greeks, who have become so habituated to misfortune, that they seem to have lost all desire of deliverance. Under these governors are the agas and *soubachis*, who are appointed over a certain number of villages, and are equally rapacious with their superiors, but still more troublesome inquisitors, being incessantly occupied in setting the inhabitants at variance, and then seizing the property of both. The Greeks have a *capitan*, or primate, chosen by themselves from their own nation, who acts as a justice of peace, in deciding all private disputes, and in watching over the interests of his countrymen. His opinion is generally submitted to without hesitation, in order to save themselves from the severe and more formidable decisions of the Turkish cadis, to whose tribunal all litigious affairs are carried as a last resort. They have, also, a *dascalos*, or writer, who keeps a register of all the names of the Greek inhabitants, and of the sums which every one must pay for their *carach*§, and to the aga, after each harvest. Besides these, and other exactions, which are altogether arbitrary, and the amount of which depends upon the population and circumstances of the inhabitants; the Greeks, in common with the Turkish land owners, are taxed with a seventh of the produce of their lands and of their olives. But what renders their situation most degrading, is the power which the agas assume over their personal liberty and domestic connections. No married man is allowed to quit the island, unless a mariner or a merchant; and every bachelor, before he is permitted to go and work in the Morea, must pay a tax of sixty parats, or two piastres. No Greek can marry without permission from the aga, and this must be purchased by a present, which, however, is not always successful. Should the young woman please this petty tyrant, he keeps her for himself. The disappointed lover must bear his misfortune in silence. Complaints are unavailing, for the cudgel is always ready to strike the reluctant slave, and should he presume to apply for redress to the pacha or the porte, he would pay for his presumption with his fortune or his life. But so destitute are this unhappy people of every generous feel ing or moral sentiment, and so seductive is vanity to the female sex, that it is uncommon for a Greek women not to be flattered with such an exaltation, which however, is but of short continuance, for, in a few years, she is turned off to make way for some more fortunate rival, and married to some Greek who dares not refuse her. Such is the shameful slavery in which this country is immersed; and Candia, once famed for the happiness of its inhabitants, and the equity of its laws, and where liberty in a manner took its birth, is now a prey to lawless oppression, and bent under the yoke of a most insulting bondage.

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* *Nat. Hist.* lib. viii cap 58.

† Belon *Observations de plusieurs singularités et choses memorables trouvées en Grece. &c.*

‡ A list of these plants will be found in Oliver's *Travels in the Ottoman Empire*, vol. ii. p. 350.

§ The *carach* is a tribute which the Grand Signior levies from all his grown up subjects who are not Mahometans

The native Candians are of the Greek church, and are allowed the free exercise of their religion; but are prohibited from repairing their religious houses or places of worship. By costly bribes, however, they obtain permission from the pachas, so far as to prevent them falling entirely to ruin. The island is divided into twelve bishoprics, viz. Gortynia, Cnossou, Mirabella, Hyera, Girapetra, Arcadia, Cherronesse, Lambis, Milopotamo, Retimo, Canea, and Cisamo. The bishop of Gortynia is appointed by the Patriarch of Constantinople, and assumes the title of archbishop. He wears a triple tiara, writes his signature in red ink, answers for all the debts of the clergy, and nominates to all vacant bishoprics in the island. He resides at Candia, and is the only Greek who enjoys the privilege of entering the city on horseback.

The situation of this island, as an emporium for commerce, can scarcely be surpassed. Placed at almost an equal distance from Europe, Asia, and Africa, it bears an equal relation to these three quarters of the world, and might be rendered the emporium of their various productions and manufactures; but, like its other advantages, this favourable position for trade is entirely neglected by the Turks, who are utter strangers to industry and the arts; and the Greeks dare not take measures to promote either the public welfare, or their private advantage. The commerce of Candia is, consequently, very inconsiderable, considering the extent of the island. The principal article of exportation is oil, which, according to Savary, in 1779, employed 24 vessels, of from 100 to 200 tons each, and the value of whose cargoes amounted annually to 2,160,000 livres, or 90,000*l.* sterling. Nineteen of these ships belonged to Marseilles, and besides oil, the French merchants, settled at Canea, purchased wax and other articles, to the amount of nearly 80,000 livres. The whole exports of the island he valued at 2,986,666 livres. The oil trade, however, since that time, has been considerably reduced, great quantities of it being now consumed in the soap houses, of which there are 25 at the town of Candia, 20 at Canea, and 8 at Retimo. Though the soap made here is not so good as the French soap, yet it is preferred by the Turks for its cheapness, and now constitutes a most important branch of exportation. It passes to Tunis, Constantinople, and all the towns of the Levant, and also to Venice and Trieste. The other exports of Candia are, wax, honey, cheese, raisins, almonds, walnuts, chesnuts, St John's bread, lintseed, and liquorice-root. The wax is chiefly purchased by the French, and consumed in Europe. A small quantity of honey, and Sphachian cheese, to the value of 30,000 livres, pass to Constantinople; raisins, and other fruits, and a small quantity of laudanum, to Egypt, Syria, and the Levant; and lintseed is purchased by the Italians; also some hones, which are likewise sent to Marseilles. The most considerable of the imports were formerly from France; but the trade with that country has, within the last 30 years, greatly decreased. In 1779, M. Savary says, that the French imported goods into Candia, to the value of 550,000 livres, which, according to M. Olivier, who visited the island in 1795, is now reduced to 160,000 livres, consisting of Carcassone woollen cloths, gilding, laces, and stuffs of Lyons, imperial serges manufactured at Nismes, small shot, tin, iron, steel, coffee, sugar, nutmegs, cloves, indigo, cochineal, paper, and various articles of hardware. From Venice and Trieste, they receive glass-ware and hard-ware, but particularly planks for making soap-cases. Their other wood is procured in Caramania or Greece. From Salonica, they draw corn, cotton, tobacco, and iron; from Constantinople, Bursa stuffs, Angora bedsteads, shoes, handkerchiefs, and copper utensils; from Smyrna, hides, Turkey leather, cotton, English shalloons, and some French goods; from Gaza, ashes; and from Syria, corn and silk. Egypt supplies them with linen cloths, flax, rice, and corn. Derna and Bengazi, on the coast of Africa, with butter; and Tunis and Tripoli with caps. In Candia, Europeans pay three per cent. in value of merchandise; the Turks only two and a half; and the Greeks, Jews, and Arminians, five per cent. Their principal maufactures are soap, some cloths in silk and cotton, and in silk and flax, also a few silk strings and ribbands, which are exported to Constantinople.

Among the people who inhabit this island, we may remark the Abadiots and Sphachiots. The Abadiots are the remains of the Saracens, who held the dominion of Candia for nearly a century and a half. They are of a middle stature, meagre and swarthy, suspicious and vindictive, and are always armed. Among themselves they speak the Arabic language, and occupy twenty little villages to the south of Mount Ida, forming a population of nearly 4000. The Sphachiots, whom we have already mentioned, are the real descendants of the ancient Cretans, and are distinguished from the other Candians by a majestic stature, a handsome countenance, and a love of liberty. They inhabit the mountains on the south of Canea and Retimo; and, amidst the many revolutions in the government of their country, have preserved their ancient language, their customs, and their laws. The other inhabitants are Turks and Greeks, amounting in all, according to Olivier, to nearly 250,000 souls,—a number very disproportionate to the extent and fertility, or even the ancient population of the island. Crete, celebrated in antiquity for its hundred populous cities, must, upon the lowest calculation, have contained above a million of inhabitants; but, since that time, it has been subjected to the tyranny of the Romans, the ravages of the Saracens, and the despotism of the Turks; and its depopulation has been gradually decreasing until now. Even in 1779, M. Savary reckons the inhabitants of Candia at 350,200, of whom 65,000 Greeks paid the carach, while M. Olivier, about fourteen years afterwards, reduces the number of Greeks subject to this tax to 20,000! Such is the effect of the imprudent and oppressive measures of a despotic government.

Were we to attempt a circumstantial detail of the various revolutions which this island has undergone since its first subjugation by the Romans, we should far exceed the bounds prescribed for such articles in this work; we intend, therefore, to confine ourselves to the more prominent events, which have brought it to its present degradation. For the ancient history of Candia, we refer our readers to the article CRETE. Before this island was conquered by the Romans, its inhabitants had greatly degenerated from their ancient simplicity and virtue. Elated by power, and enervated by prosperity, they had become turbulent, covetous, and ambitious. The Archipelago was infested with their piratical fleets, which disturbed the tranquillity, and molested the commerce of the neighbouring states; and they continued their depredations, till the Rhodians armed themselves for the general defence, and succeeded in sinking, burning, and dispersing their squadrons. When attacked by the Romans, a spark of their ancient valour still guided them in battle, and it was not till after a long, obstinate, and vigorous resistance, that the Cretans were obliged to yield to the talents and fortune of Quintus Metellus, in the year 66 B. C.; when the laws of Minos were abolished, and those of Numa established in their stead. This island, in conjunction with the small kingdom of Cyrene, on the Lybian coast, was then converted into a Roman province, and governed by a proconsul. It continued under the dominion of the Roman emperors till the beginning of the 9th century, when the Saracens, invited by the beauty and fertility of the island, landed without opposition, and built the strong fortress of Chandak, which afterwards, under the Venetians, assumed the name of Candia. From this citadel, they carried havoc and devastation into the interior of the country; and, notwithstanding the efforts of the emperor Michael Balbus, they soon made themselves masters of the whole island. Repeated attempts were made both by Michael and his successors, to expel the Saracens from Crete, but without success; and it was reserved for the Emperor Nicephorus Phocas to deliver this fine island from the yoke of the infidels. After various encounters in the field, he drove them to their fortresses, which he successively reduced, and in 912 took Chandak, their last resource, with their king Curup, and his lieutenant Aremas, prisoners. The island was again united to the empire, of which it continued to form a part till the taking of Constantinople by the Crusaders, when Baldwin, count of Flanders, being raised to the throne, bestowed it, with several other islands in the Archipelago, upon the Venetians in 1204, as a recompence for their important services during the war. Under the wise and liberal government of the Venetians, the commerce and agriculture of Candia soon began to revive; and in a short time it became a most flourishing conquest. The Genoese, jealous of the growing prosperity of their sister republic, excited the Candians to revolt, and promised them powerful succours. Some of their chief men, accordingly, appeared in arms; but, though powerfully supported by the Genoese, they were unable to withstand the bravery of the Venetians, who soon reduced them to obedience, and divided the whole island among the nobility, upon condition that they should maintain it at their own expence, pay an yearly tribute, and acknowledge the sovereignty of the mother country. The peace of the island being re-established, it continued with little interruption till the middle of the 17th century; when the Turks, who had made several attempts upon Candia, obtained by perfidy, what they could not accomplish by open force. During the preparations of a mighty armament which was to be employed against this island, the emperor of Constantinople deceived the Venetian ambassadors with the most solemn assurances, that Malta was the object of attack, and that the republic might be under no apprehensions for the safety of her possessions. He even loaded them with presents, and directed his fleet to bear for Cape Matapan, as if they were bound far west of the Archipelago. But in the midst of his protestations of amity, the Turkish fleet, consisting of 400 sail, with 60,000 troops on board, entered the bay of Canea, in 1645. The Venetian governor, Cornaro, who had made no preparations for their reception, was awakened from his seeming security only by the intelligence of their descent upon the island. A body of 3500 infantry, and a small number of cavalry, were the only force he had to oppose to this powerful armament; and his distance from Venice deprived him of all hope of a speedy reinforcement. The Turks having seized the forts upon the island of St Theodore, invested the city of Canea, whose garrison consisted only of 1000 regular troops. These, however, being strengthened by 250 more, which Cornaro found means to throw into the city, made a most desperate resistance. Monks and women appeared upon the walls among the defenders; and for two months they held out against the mighty power of the Turks. Despairing at last of relief from Venice, with three breaches in their walls, and reduced to 500 men, exhausted with fatigue and covered with wounds, they made an honourable capitulation, and marched out of the city with the honours of war. Twenty thousand Ottomans was the sacrifice which the Caneans had exacted for the loss of their city. The fall of Retimo soon succeeded, with the death of Cornaro, who fell in the ranks of his soldiers, when boldly opposing the approach of the Turks to that city; and the victors sat down before Candia in 1646. Many heroic deeds of valour were performed before this city, and its siege is one of the most memorable recorded in history. For two years, the Turks made little or no progress. They were routed in many desperate and bloody encounters, and sometimes compelled to retire to Retimo, in order to recruit their shattered forces. In the mean time, the plague had been introduced into the island by some Turkish reinforcements, and had spread with such rapidity, that many of the inhabitants fell before its fury, and others, to escape its ravages, had fled into the Venetian territories on the continent. Candia was thus in a manner depopulated; scarcely a Greek was to be seen in the open country, for such as had escaped from the pestilence took refuge in the different fortresses; and the Turks themselves had suffered so much, both by disease and the sword, that they were compelled to raise the siege in 1649, and retire to Canea. But in the following year, they were enabled, by the arrival of fresh troops, to renew the siege, which they prosecuted with such vigour, that they soon made themselves masters of one of the advanced forts. This being turned against the city, proved so troublesome to the besieged, that they were obliged to blow it up. The Venetians, however, had now got possession of the sea. The Ottoman fleets had been defeated in several engagements, and their supplies were every year intercepted in the Straits of the Dardanelles. Depressed by some severe losses, and the want of succours, the Turks had converted the siege of Candia into a blockade; while the Venetians, on the other hand, elated by success, attempted the recapture of Canea in 1660, which, however, when about to surrender, was snatched from their grasp by the appearance of the Pacha of Rhodes, who having escaped the Venetian gallies which were stationed to intercept him, but which were becalmed off Cape Spada, reinforced the defenders with two thousand men. The Turks were now commanded to appear again before Candia, and to make every possible effort for its reduction. For six years, however, their efforts were unavailing, and it was not until they had been reinforced by a formidable army under the Grand Vizier, and supported by a numerous artillery, that they made any impression upon the Venetian works. A rapid demolition now commenced. All the exterior forts were destroyed; and the walls, battered by incessant discharges of cannon, gave way on all quarters. The Turkish troops, encouraged by the presents and promises of their chiefs, performed prodigies of valour; and during one year (1667) it is recorded, that 500 mines were blown up; 18 combats were fought in the underground works; 17 sallies were made by the besieged; 32 times the city was assaulted; and 20,000 Turks and 3000 Venetians fell in the contest. The Candians, however, though reduced to the most dreadful extremities, were still undismayed, and held out for three years more against all the forces of the Ottoman empire. Succours from France, under the Duke of Noailles, had animated their hopes. But the first sally of their new allies was discouraging and disastrous, and soon led to the surrender of their city. The command of the forlorn hope had been entrusted to the Duke of Beaufort, admiral of France. He advanced furiously against the enemy, and attacked him within his trenches; but in the midst of the engagement, a magazine of powder was set on fire, when Beaufort and the flower of the French leaders disappeared for ever. The soldiers fled in disorder, and the Duke of Noailles with difficulty effected a safe retreat within the city. The French accused the Venetians of treachery, and prepared to reimbark. Their departure determined the fate of Candia, which, after a siege of 24 years, surrendered to the Turks. Of more than 30,000 Christians that had entered this city since the beginning of the siege, 500 only remained; and above 100,000 Ottomans perished at the foot of its walls. The Grand Vizier entered Candia on the 4th of October 1670, and the whole island submitted to his dominion, except the forts of Sude, Grabusa, and Spina Longua. These continued in the possession of the Venetians until 1715, when they were reduced by the Turks, who have remained masters of the island ever since.

Besides the division of this island into governments, these are subdivided into provinces, which we shall content ourselves at present with merely enumerating. In the government of Canea are Kissamos, Selino, Cydonia, and Apocorona; in the pachalic of Retimo are, Retimo, Aion-Vassali, and Amari; and in that of Candia are, Sphachia, Candia, Nilo-Potamo, the island of Stan-Dia, Messara, Mirabel, Hiera-Petra, and Settia. See Savary's *Letters on Greece*, p. 203, &c.; Oliver's *Travel's in the Ottoman Empire*, vol. ii. p. 266, &c.; and Sonnini's *Travels in Greece and Turkey*, p. 209, &c. (*p*)

CANDIA, the capital of the island of Candia, and from which the island derives its name, is situated on a beautiful plain, watered by the river Ceratus. It is supposed, both by Savary and Sonnini, to occupy the site of the ancient Heraclea; but Olivier rather refers it to port Panormus, which, according to Ptolemy, lay between Cytæum and Heraclea. It received its present name from the Saracens, who, on their first arrival upon the island, built the fortress of Chandak, which, in the Arabic language, signifies "entrenchment," and which was converted by the Venetians into Candia.

This city is of a semicircular form, about four miles in circumference, and is strongly fortified by walls, ditches, and advanced works; and its approaches by sea are defended by a strong wall, built on rocks, and mounted with several pieces of cannon. Its streets and squares are regular and well built, and are evidently the work of the Venetians; but several divisions of the city are void of inhabitants, many of whom, together with the foreign merchants, have removed to Canea. It is, however, still the residence of the Pacha Serasquier and his military council, which consists of a kyaia or lieutenant, an aga of the janissaries, two commanders of the artillery, a treasurer-general of the imperial revenues, a keeper of the imperial treasury, and the chief officers of the army. Of the many beautiful churches built by the Venetians, three only are now possessed by the Christians, the handsomest having been converted into mosques. The Jews have a synagogue here, and the Capuchins a small convent. The harbour of Candia is naturally a fine bason, securely sheltered from every storm; and, if properly cleared, would contain from thirty to forty sail of merchant vessels. But the Turks, by their general improvidence, have allowed it to be so choked up with mud and sand, that boats and the small barks of the country only can enter it, and the docks and arsenals, which were constructed by the Venetians for building gallies, and putting them under cover when laid up, are also allowed to fall fast into decay. Ships that load at this port must take in their cargoes at Stan-Dia, a small island about four leagues off, and opposite to Candia, where the goods are conveyed in boats, and where there are three capital road-steads in its south quarter. From this inconvenience, the trade of Candia, which was so extensive and flourishing under the Venetians, is now almost annihilated; and with its trade have also fled the majority of its inhabitants. Its population scarcely amounts to 14,000, of whom 2000 or 3000 only are Greeks, and 60 Jews. Candia is chiefly famous for its siege; for which, see the preceding article, and the references subjoined to it. N. lat. 35° 19′, E. long. 25° 18′. (*p*)

CANDLE, is an article so well known in domestic economy, as to render any description of it entirely superfluous. The term is obviously derived from the Latin *candela*, and that from *candere*, to burn. Candles are by no means a modern invention, though lamps seem to have been chiefly used by the ancients for domestic purposes. Mention is made of something like candles, both of tallow and wax, and not unfrequently of pitch. The wicks were originally small cords; afterwards the papyrus and the pith of rushes were used. But the ancients seem at no time to have been able to produce an article in any degree to be compared with the candles of modern times.

Candles, as we shall notice afterwards, may be manufactured from a great variety of substances, but those chiefly employed are tallow and wax.

1. *Tallow Candles.* Candles made from tallow are either dipped or moulded. The first kind are the candles in common use, and have been long known in commerce; the second sort is a more recent invention, and claimed by a Parisian. We propose to give our readers a short account of the mode of manufacturing both kinds.

The tallow employed by the candlemaker consists chiefly of ox and sheep tallow. That obtained from the hog is rarely used, on account of the bad smell which it has in burning, as well as a thick black smoke; but chiefly on account of its being easily melted, a quality of the very worst kind, as will be shewn afterwards.

The first part of the process of candle-making is to sort the tallow. Sheep-tallow, with a portion of the best ox-tallow, is set aside for the moulded candles. Candles made principally from sheep-tallow have a better gloss and firmer texture than those which are manufactured wholly from ox-tallow. This last kind, with the inferior pieces of sheep-tallow, are used for making dipped candles. The quality of the candles depends as much upon the care and cleanness with which the tallow is collected by the butcher, as upon the species of animal from which it is derived; but, even where the greatest care is employed, parts of the tallow must necessarily be mixed with impurities, which cannot afterwards be completely separated from it. The extensive manufacturer will therefore select not only the tallow for the finer candles, and for those of common use, but will separate from his stock the inferior pieces of tallow, and such as are mixed with impurities, in order to dispose of them to the inferior dealer. After the tallow is properly sorted, it is then put into a wooden vessel, and cut into small pieces preparatory to the first melting, which, in the technical language of the workmen, is called *rendering*. Much depends upon this operation being performed as soon as possible after the tallow comes from the hands of the butcher. If the tallow is allowed to remain for several days exposed to the action of the air, which must often happen to the inferior dealer, who receives his tallow in small quantities, and at considerable intervals, part of it will corrupt and infallibly injure the whole mass; but if the tallow is *rendered* soon after it comes from the slaughter-house, it may be kept for months or years, and even improved by keeping, provided the temperature is moderate. The object of this operation, is to separate from the tallow the skin and fleshy parts which always adhere to it, and expel, by evaporation, the aqueous particles or other liquids which are combined with it. With this view, the tallow, after being cut into small pieces, is thrown into a large boiler, and heat gradually applied. As the tallow melts, new portions are added; and particular care is taken to stir it frequently, in order to prevent the more solid parts from adhering to the bottom of the vessel. After boiling a considerable time, the more solid parts collect at the surface in the form of a cake, which is called the *crackling*: part of the liquids have been driven off by the boiling, and the remainder subsides to the bottom after the boiling ceases. The cake is then put into a strong press, and a great pressure applied, in order to extract from it every particle of tallow; it is afterwards set aside to be sold for food to dogs and other animals. The liquid tallow is now taken from the boiler and put into an adjoining vessel, by making it pass through an iron sieve, by which means any of the solid parts which have not united with the cake are separated from the liquid mass. Still, however, many foreign substances will remain blended with it. In order to purify it still more, the tallow is now put into another vessel, and a certain quantity of water mixed with it. The water being specifically heavier than the tallow, sinks to the bottom, and carries along with it any impurities which may have escaped the operation of the sieve. After standing a sufficient time for the impurities to settle, this tallow is transferred, by means of tinned iron buckets, into tubs of a moderate size, and allowed to congeal. It is then taken out of the tub in a solid state, and piled up for future use. In transferring the tallow from the large vessel into the tubs, great care must be taken not to agitate it too much, lest the slimy matter collected at the bottom rise and mix with it again. To prevent this inconvenience, the workmen usually cease emptying the vessel when they come within an inch or more of the slimy matter, which they readily discover by its muddy white colour. The residue of the tallow is allowed to remain in the vessel during the night, and in the morning it is taken out in a solid state, and set apart to be re-melted with new tallow.

From this statement, it appears, that in the preparatory process of *rendering*, water is an indispensable requisite; and that in one stage or other of the process, it must be mixed with every portion of the tallow. We are at a loss, therefore, to understand the meaning of that caution uniformly given to candlemakers by our fellow Encyclopædists, not to mix water with the tallow intended for the three first dips. To those who have seen the gross impurities which are disengaged by the water, it must appear obvious that water, or some other agent of a similar nature, must be employed to remove those foreign substances, which, if allowed to remain blended with the tallow, would produce consequences far more destructive to the candle than the spitting, of which they seem so much alarmed. But, in this case, there is certainly no occasion for a balancing of evils; for, if the water, after being mixed with the tallow, be allowed to subside, and if the tallow be taken off in the manner above described, scarcely any moisture will adhere to it; and whatever may happen to remain, will infallibly be driven off by the new boiling, preparatory to its being used for making either dipped or moulded candles. This caution seems to have been suggested by a practice not unusual with the small manufacturer, of putting water into the dipping mould in order to supply the want of tallow. In this case, the caution is certainly well-timed, and highly deserving of attention, but quite inapplicable to the trade in general, who, it is to be supposed, have no necessity for having recourse to such expedients.

After having sorted and purified the tallow in the manner above described, the candlemaker now proceeds to cut and arrange the wicks, which, with the exception of such as are intended for the coarser dipped candles, are made of fine spun cotton. The cotton usually employed is chiefly obtained from Turkey, and comes into the hands of the candlemaker in the form of skeins. Four or more of these skeins, according to the intended thickness of the wick, are wound off at once into bottoms or clues, and afterwards cut by means of a very simple machine, into pieces of a particular length, corresponding to the size of the intended candle. Before putting the wicks into the moulds, or placing them on the sticks for dipping, it is usual to dress them, by slipping them between the fingers and thumb, with the view of laying the threads smooth, and removing knots and such foreign substances as might injure the candles. Even after "this dressing," it is difficult, in consequence of the shrinking of the cotton, to keep the wicks, when placed upon the broaches, completely separate from each other. To obviate this inconvenience, it is usual to take a great number of wicks into the hand, and dip them into melted tallow. After rubbing them between the palms of the hand, and allowing the tallow which adheres to harden, they may be arranged with perfect ease upon the broaches.

We shall now describe the process of dipping and moulding. The dipping-room is furnished with three important pieces of apparatus, viz. a boiler for melting the tallow, the dipping-mould, and a large wheel for supporting the broaches. The first part of the process must obviously consist in remelting the tallow, which had been previously *rendered*, and set aside in a solid state. The expense and trouble of remelting is sometimes saved by commencing the operation of dipping immediately after the rendering, or before the tallow cools; but the saving thus effected is not to be compared with the advantage gained by employing tallow of different ages. We are told, that a mixture of tallow recently rendered, with some of ten or twelve months standing, is the best for making either dipped or moulded candles. The melted tallow, after being carefully skimmed, is transferred into the dipping mould by means of ladles or small buckets, in such quantities as may be required. The dipping-mould is nothing else than a box of an oblong form, lined with lead, of about three feet in length, two in breadth, and two feet in depth, erected on a frame at such a height as to suit the convenience of the workman, who sits on a chair beside it. To the extremities of the box are sometimes attached two leaves or boards, to receive the droppings of the candles as they rise successively from the dipping-mould. This additional piece of apparatus may, however, be dispensed with, provided the workman is careful to raise the candles slowly from the liquid mass; or, what is to the same purpose, to allow the suspended drops again to touch the surface of the tallow. To prevent the tallow in the dipping mould from freezing, or becoming less liquid than the process requires, it is usual, in some manufactories, to place a chaffing-dish below the dipping-mould, for the purpose of keeping the tallow at the proper temperature. When the tallow is kept very hot in the adjoining boiler, and when the process of dipping proceeds with such rapidity as to occasion a constant renewal of the tallow in the dipping-mould, it will be found that a chaffing-dish is quite unnecessary, except in very cold weather. At each supply, however, of new tallow, the workman ought to be careful to remove from the sides of the vessel whatever may have hardened in the interval. Things being thus arranged, the workman, according to the first plan of dipping, takes into his hands three sticks or broaches, on which has previously been suspended a certain number of wicks, corresponding to the size of the candles intended to be made, and keeping them at an equal distance from each other by means of his second and third fingers, he immerses the wicks two or three times in the liquid tallow, and then hangs the rods upon a rack to cool. The same operation is repeated several times, till the candles acquire the proper thickness. With the view of facilitating the process of dipping, and in order to diminish the fatigue of the workmen, the following improvement, we are told, has for more than fifteen years been practised by the London manufacturers. From the ceiling of the workshop is suspended a long beam in the shape of a balance, to one extremity of which is attached a wooden frame for holding the broaches, with the wicks arranged at proper distances: the opposite arm is loaded with a weight to counterbalance the wooden frame, and to enable the workmen to ascertain the proper size of the candles. The end of the lever which supports the frame (it is almost unnecessary to observe) is placed immediately above the dipping-mould; and the whole machine is so adjusted, that, by a gentle pressure of the hand, the wicks are let down into the melted tallow as often as may be required. After the first dipping, the frame is removed and hung up to allow the candles to cool, and the same operation is repeated till the candles acquire the proper size. It is obvious, that the only advantage gained by this improved method, is a small increase in the number of broaches, and a partial diminution of the labour of the workman. Much delay is still occasioned by the tardy system of cooling; and the necessity of removing the frame after each dipping is certainly a great inconvenience. Many of these disadvantages, we think, are completely removed by the following method, which has been practised for several years in Edinburgh:

In the centre of the dipping-room is erected a large upright shaft AA, which turns easily on its two extremities. See Plate CVIII. Fig. 8. Near the middle of the shaft are cut, at small distances from one another, six mortises, into each of which is inserted a long bar of wood BB, which moves vertically upon an iron pin also passing through the middle of the shaft. The whole presents the appearance of a large horizontal wheel with twelve arms. A complete view of two of them only is given in the figure. From the extremity of each arm is suspended a frame, or *port*, as the workmen call it, containing 6 rods, on each of which are hung 18 wicks, making the whole number of wicks upon the wheel 1296. The machine, though apparently heavy, turns round by the smallest effort of the workman; and each *port*, as it comes in succession over the dipping-mould, is gently pressed downwards, by which means the wicks are regularly immersed in the melted tallow. As the arms of the levers are all of the same length, and as each is loaded with nearly the same weight, it is obvious that they will all naturally assume a horizontal position. In order, however, to prevent any oscillation of the machine in turning round, the levers are kept in a horizontal position, by means of small chains *a a*, one end of which is fixed to the top of the upright shaft, and the other terminates in a small square piece of wood *b*, which exactly fills the notch *c* in the lever. As one end of the levers must be depressed at each dip, the square piece of wood is thrown out of the notch, by the workman pressing down the handle D, which communicates with the small lever *e*, inserted into a groove in the bar B. In order that the square piece of wood fixed in one extremity of the chain may recover its position upon the workman's raising the *port*, a small cord is attached to it, which passes over a pulley inserted in a groove near *c*, and communicates with another pulley and weight, which draws it forward to the notch. In this way, the operation of dipping may be conducted by a single workman with perfect ease and regularity, and even dispatch. No time is lost, and no unnecessary labour expended in removing the *ports* after each dip; and, besides, the process of cooling is much accelerated by the candles being kept in constant motion through the air. The number of revolutions which the wheel must make in order to complete one operation, must obviously depend upon the state of the weather and the size of the candles: but we are told, that, in moderately cold weather, not more than two hours are necessary for a single person to finish one wheel of candles of a common size. Upon the supposition, therefore, that six wheels are completed in one day, no less a number than 7776 candles will be manufactured in that space of time by one workman.

It is of the greatest consequence, both for the purposes of commerce, and with a view to levying the duty, that a certain number of candles should regularly amount to a definite weight, and consequently that the operation of dipping cease at the precise time when the candles have attained this weight. In order to ascertain this important point, the workman, when he thinks the candles have nearly acquired the proper size, lifts one of the broaches from the end of its lever, and hangs it upon the arm of a balance placed beside him, whose opposite scale has been previously loaded with the proper weights.

We shall next describe the process of moulding, which, if possible, is even less complicated in its details than that of dipping. The moulds are made of some metallic substance, usually pewter, and consist of two parts. The shaft, or great body of the mould, is a hollow cylinder, finely polished in the inside, and open at both extremities. The top of the mould is a small metallic cup, having a moulding within side, and a hole to admit the wick. The two parts are soldered together; and, when united, as will readily be imagined, have the shape of a moulded candle. A third piece, called the foot, is sometimes added: it is a kind of small funnel, through which the liquid tallow runs into the mould, and being screwed to the opposite extremity of the shaft, is removable at pleasure. This additional piece may certainly be useful in very mild weather; since, by removing it, the candles may be drawn more easily from the moulds; but, in general, it may be dispensed with. It is seldom used, and indeed is scarcely known in any of the large manufactories of Scotland.

Twelve or sixteen of these moulds, according to their size, are fixed in a frame, which bears a great resemblance to a wooden stool, the upper surface of which forms a kind of trough. The top of the moulds points downwards; and the other extremity, which is open, is inserted into the bottom of the trough or top of the stool, and made quite level with its upper surface. In order to introduce the wicks into the mould, the workman lays the frame upon its side on an adjoining table, and holding in his left hand a quantity of wicks, previously cut to the proper length, he introduces into the mould a long wire with a hooked point. As soon as the hook of the wire appears through the hole in the top of the mould, he attaches to it the looped end of the wick, and immediately drawing back the wire, carries the wick along with it. In this manner each mould in succession is furnished with a wick. Another workman now follows, and passes a small wire through the loop of each wick. This wire is obviously intended to keep the wick stretched, and to prevent it from falling back into the mould, upon the frame being placed in the proper position for filling. The frame is now handed to the person that fills the moulds, who previously arranges the small wires in such a manner that each wick may be exactly in the middle of the mould.

The moulds are filled by running tallow into the trough from a cistern furnished with a cock, and which is regularly supplied with tallow of the proper temperature from an adjoining boiler. When the workman observes that the moulds are nearly half filled, he turns the cock, and laying hold of that portion of the wick which hangs out of the mould, pulls it tight, and thus prevents any curling of the wick, which might injure the candles. He then opens the cock, and completes the process of filling. The frame is now set aside to cool; and when the tallow has acquired a proper consistence, which the workman easily discovers by a snapping noise emitted by the candles upon pressing his thumb against the bottom of the moulds, he first withdraws the small wire, which kept the wicks tense, and then scraping off the loose tallow from the top of the frame with a small wooden spade, he introduces a bodkin into the loop of the wick, and thus draws each candle in succession from its mould. The candles are now laid upon a table for the inspection of the exciseman, and afterwards removed to the storehouse. Previous to storing them up, some candle-makers bleach their candles, by exposing them to the air and dews for several days. This additional labour can be necessary only when the dealer is obliged to have early sales; for if the candles are kept for some months, as they ought to be, before they are brought to market, they become sufficiently whitened by age.

Besides the common dipped and moulded candles, a kind of candle intended to burn during the night without being snuffed, is also made of tallow. These candles are usually called rush-lights, from the wick being made of split rushes.

II. *Wax candles.* Next to tallow, the substance most employed in the manufacture of candles is wax. Wax candles are made either by the hand or with a ladle. In the former case, the wax being kept soft in hot water, is applied bit by bit to the wick, which is hung from a hook in the wall; in the latter, the wicks are hung round an iron circle, placed immediately over a large copper tinned bason-full of melted wax, which is poured upon their tops, one after another, by means of a large ladle. When the candles have, by either process, acquired the proper size, they are taken from the hooks and rolled upon a table, usually of walnut-tree, with a long square instrument of box, smooth at the bottom. As the candles must be rolled one by one, in order to preserve their warmth, and keep the wax soft, those made with the ladle are laid, previous to the rolling, in a feather-bed folded in two, at convenient distances from one another. The same precaution is not so necessary with the candles made by the hand, as they may be rolled just as they are formed. Besides the common cylindrical form, wax candles are sometimes made of a conical figure, and are intended chiefly to illuminate churches, and to be used in processions and funeral ceremonies. The pyramidal form is given them, by pouring the wax upon the wicks at different heights: the three first ladles are poured on at the top of the wick; the fourth ladle at the height of three-fourths; the fifth at one-half; and the sixth at one-fourth. Candles of this shape, after being rolled and smoothed, have their big end cut off, and a conical hole made in it to receive the point in the candlestick. There is still another kind of wax candle, or taper, said to be the invention of Pierre Blassimmere of Paris, and brought by him from Venice about the middle of the 17th century. The process consists in making a wick, of some yards in length, pass several times through a brass bason of melted wax, and at the same time through the holes of an instrument like that used for drawing wire, by means of two rollers of wood turned by a handle.

We shall now give an account of the different improvements which have been suggested upon the manufacture of the common candles, and mention some of those substances which have been proposed as substitutes for tallow and wax. It will be necessary, however, previously to explain the process of burning in candles, and to state the comparative advantages of the two substances usually employed.

The wick of the candle being always a combustible substance, readily catches fire upon the application of a flame. The heat thus produced fuses a portion of the tallow, or wax, which immediately rises through the fibres of the wick by a kind of capillary attraction. The melted matter, as it approaches the flame, is gradually volatilized and set on fire; a new portion of melted tallow, or wax, ascends in the same manner, and is, in its turn, heated and burned: and in this way a constant combustion is maintained. A candle differs from a lamp, chiefly in the circumstance, that the tallow, or wax, is melted gradually, and in small quantities, and is retained in a cup formed by the solid part of the candle. As this cup must obviously be of very small dimensions, it is of the last consequence that the quantity of matter melted never exceed the power of the wick to absorb it, otherwise the candles will gutter. The size of the wick, therefore, must always be proportioned to the fusibility of the substance employed; the more fusible substance obviously requiring the larger wick. Of the two substances commonly used, wax is the least fusible. Tallow melts at 92° of Fahrenheit, spermaceti at 133°, and bleached wax at 155°. The flame of wax is less brilliant than that of tallow, which is supposed to be owing to the wax being already combined with a portion of oxygen. This disadvantage, however, is more than compensated by its being less fusible; by which means a smaller wick may be used, which not only affords the advantage of a clear perfect flame, but, in consequence of its flexibility, it naturally falls to one side, and, by thus coming in contact with the air, is burnt to ashes. The wick of the tallow candle being much larger, preserves its position in the centre of the flame, which is less perfect, from its internal part not being completely exposed to the action of the air. As the burning proceeds, the wick lengthens, and, consequently, the distance between its top and the point of the flame diminishes; from which it follows, that the oil which issues from the extremity of the wick, having a smaller portion of flame to pass through, will be less perfectly burnt, and will pass off partly in smoke. The wick soon rises above the top of the flame; but, owing to its size, and the quantity of oil which it contains, it is not converted into ashes, and dissipated, as in the case of the wax candle. On the contrary, the half decomposed oil is converted into a kind of coal, or soot, which gradually accumulates upon the top of the wick, and assumes the appearance of a fungus. In order, therefore, that a tallow candle may burn with any degree of clearness, constant snuffing is requisite.

From the above statement, it appears, that the chief difficulty in improving the burning of the tallow candles, arises from the great fusibility of the tallow. Several attempts have been made to remove, or at least to lessen, the evil, but none of them have completely succeeded. If it were possible, by means of some chemical agent, to produce such a change upon tallow, as to raise its melting point several degrees, and there is reason to believe, that some such change is produced in wax by the absorption of oxygen; this, certainly, would be the most direct method of removing the evil. Several chemists, and, among others, Mr Nicholson, have engaged in experiments with this view; but we are not aware that their success has been in any degree equal to the importance of the object sought after. As a substitute for this *desideratum*, it has been proposed to strengthen the cup by covering the tallow with a thin coating of wax. A candle of this kind, called *lobchock*, is known at Canton in China. Mr Nicholson informs us, that he attempted to imitate this Chinese candle, by pouring a quantity of wax into a mould, and immediately pouring it out again before running in the tallow. In this way he covered the tallow with a thin film of wax; but owing, perhaps, to the wax naturally contracting more than the tallow in cooling, or to the sudden cooling of the wax before the tallow was poured in, he found, upon drawing the candle, that it was cracked longitudinally on its surface. At any rate, it is not at all likely, when we consider the additional labour and expence connected with the manufacture of this species of candle, that it will ever become an article of general use.

The next expedient employed, was to make an artificial cup; which, in fact, is nothing else than burning the tallow in a lamp. With this view, a hollow brass tube is attached to the top of a cylindrical piece of tallow, or a candle without a wick. The upper aperture of the tube is partly closed with a ring, in the centre of which is inserted a small metallic piece, nearly resembling that part of the common lamp which carries the wick, with which it is also provided. The tube rests upon the upper extremity of the candle, and is so nicely adapted to its size, that it slides gently down as the tallow consumes. The flame produced in this way is brighter, and more uniformly intense, than that of a candle of the same size, and is, at the same time, free from all disagreeable smell; but it was found, that the heat acquired by the metallic piece, during the combustion, fused more tallow than the wick could take up; and, consequently, that part of the melted tallow flowed down between the candle and the brass tube, and, upon cooling, fastened them together in such a manner, that the gradual progression of the tube, and the necessary supply of tallow, was obstructed. An invention, upon a similar principle, was proposed, about twelve years ago, by Mr William Bolts of London, for which he obtained a patent. The great object of this invention, is to get rid of the trouble of constant snuffing, and to prevent the running of the candles. To accomplish this, he employed a solid candle, or cylindrical piece of tallow, to the top of which he applied a small wick, by means of a projecting spring. The wick was kept in contact with the upper surface of the candle, either by making the wickstand pass round the candle like a collar, and slide down by the pressure of a spring, or, by making the wick immoveable, and putting a spring at the bottom of the candlestick, which presses the candle upwards as the tallow is consumed. Instead of a solid candle, he sometimes used one having a perforation longitudinally; on the top of which he placed, for a wick, a small tuft of cotton; to the lower end of which was attached a thread, which passed down through the perforation to the bottom of the candle, and was wound round a key, or pivot. By turning this pivot, the wick is brought down as the candle consumes. In this way, the wick being kept constantly soaked in the melted tallow, consumes very slowly, and, consequently, supersedes the necessity of snuffing. The size of the wick may also, by this contrivance, be proportioned to that of the candle, and the fusibility of the material employed; while, by the action of the spring, or pivot, the flame may be made to approach or recede, as circumstances require. This contrivance, however, requires too much attention for common use, and is obviously too complicated. The only other attempt at improving the wick, which deserves notice, is that of the candlemakers of Munich, who use a thin slip of wood bound round with unspun cotton to the thickness of a small quill. These slips are made of pine, willow, and other kinds of wood, but most commonly of fir. They are prepared by first scraping off the bark, and reducing them to the size of a small straw. They are then rubbed over with wax or tallow, and afterwards rolled on a smooth table, on very fine carded cotton. When they have acquired the proper size, they are introduced into the moulds, or hung on the dipping frame, as formerly described. These candles, we are told, besides burning longer than the common ones, do not blaze, and are less prejudicial to the eyes of those who are accustomed to read or write at night. They must be snuffed with a pair of sharp scissars, and great care must be taken not to break or derange the wick.

Various methods of purifying the tallow, and rendering it more firm and compact, are described in the *Dictionaire de l'Industrie*, under the article *Chandelle*. In all these processes, alum seems to be the chief agent, to which is sometimes added nitre and sal ammoniac. In order to give tallow the appearance of wax, quicklime is used in purifying it, and sometimes vinegar. The tallow thus prepared, when mixed with an equal portion of wax, makes very beautiful candles. Several attempts have been made to deprive tallow of the bad smell, but none of them have completely succeeded. A decoction of rosemary, sage, laurel, and wild mint, has been used; and the powder of charcoal has been suggested: the former, however, it is likely, only conceals the odour without removing it, and, at any rate, could scarcely be employed on a great scale; the effect of the latter, as far as we know, has not yet been ascertained. In the *Archives des Decouvertes*, published at Paris in 1810, M. Bonnatin announces a new method of purifying tallow, by which it is deprived of all colour and humidity, and may be kept for several years without becoming either yellow or rancid. The process is kept a secret; but M. Vauquelin has examined the tallow, and his report is favourable. The candles made from it are distinguished by the purity of their light, and the absence of smoke, but chiefly by their not running, and their requiring to be seldom snuffed.

We have already mentioned, that tallow, purified with quicklime, is sometimes mixed with wax, in order to improve the candles, or, rather, to diminish the price. In the *Journal de Paris* for 1787, is announced the discovery of a new species of wax candles, made of wax and the pulp of potatoes. The wax extracted from the fruit of the waxtree, when mixed with a portion of common wax, or, what is better, with tallow, makes excellent candles, which diffuse an agreeable odour in burning. Candles have also been made of the butter of the cocoa-nut, and of an oil extracted from the brain of the whale, which, after being exposed to the air, soon acquires a considerable degree of consistence. Candles made of the latter material are covered with a slight varnish; and those made from the cocoa burn with a clear steady flame, and last much longer than tallow candles.

We shall conclude our remarks with a short abstract of the excise laws respecting candles.

These laws relate chiefly to four points, viz. the license for making and selling candles; the additional duty levied by the weight; the checks upon smuggling; and the penalties to be exacted for neglecting or opposing the provisions of the act. The license to make wax candles is 6*l*. and 1*l*. for tallow candles. The license to sell is 10*s*. 6*d*., and both must be renewed annually; but those who take the license for making, are not obliged to take the license for selling also during the same year. The additional duty upon wax candles is 3½*d*. per lb. and that on tallow candles 1*d*. The checks upon smuggling consist in allowing the excise-officers to lock up and seal all furnaces, moulds, &c. made use of in the manufacture of candle, and to open them only upon notices from the manufacturer: these notices to be given in at the head office six hours, in a city or market-town twelve hours; and elsewhere within twenty-fours before they are to be used. The penalties in general are 20*l*., 50*l*., and 100*l*.; but never exceed the last sum. (s)

CANDY. See CEYLON.

CANE. See SUGAR.

CANEA, a seaport town of Candia, lies on the north side of the island, at the eastern extremity of a large bay, and is supposed to occupy the site of the ancient Cydonia. Canea is of an oblong figure, about two miles in circumference, and defended by a strong wall and a broad and deep ditch cut through a bed of rock. It has four bastions on the land side, and a raveline at the north-east corner. Towards the sea, on the left of the harbour, are four batteries mounted with heavy cannon, and, on the right, is a strong wall extending along a chain of pointed rocks, at the extremity of which is an old castle now falling into ruins. The streets are straight and spacious, the squares are adorned with fountains, but there are no buildings in it worthy of notice. The houses are mostly of one story, with flat roofs forming a terrace; and some of them, which are contiguous to the harbour, are adorned with balconies, which command an extensive prospect of the bay, formed between Cape Spada and Cape Melecca. Canea is the most flourishing, and in proportion to its extent, the most populous city of Candia. It carries on a considerable trade in olive oil and soap. It exports wax and honey to the Archipelago, and wine to all parts of the Levant. The harbour, however, which, by a little attention, might be rendered both safe and commodious, is completely neglected by the Turks. Vessels are allowed to throw overboard whatever incommodes them, and not unfrequently a part of their ballast. The basin is thus choked up, and can now scarcely admit ships of two hundred tons burden. The immense arsenals built by the Venetians are also falling to ruins. They are vaulted with stone, and sufficiently large for containing a ship of the line, which, from the nature of their situation, might be built there, and then launched into the water. But Turkish indifference is a complete bar to every species of improvement, for promoting the commerce and the public prosperity of the country. M. Savary reckons the population of this city at 15,000 souls; while Olivier reduces it to little more than 7000, among whom are upwards of 4000 Turks, 2000 or 3000 Greeks, 150 Jews, 4 French houses, and some Italians.

In the neighbourhood of Canea are some fine forests of olive trees, intersected with cultivated fields, orange groves, vineyards, and gardens. The rocks are covered with the famous dittany of Crete, so celebrated by the ancients, which is gathered by the peasants into small bundles, and brought to market. Near this town are huts erected for the accommodation of lepers, who subsist upon the produce of a small garden, and the alms of passengers; and on the side of the highway are exposed the bodies of criminals, who have undergone the dreadful punishment of empalement. "They are ranged," says M. Sonnini, "on each side of the road; and in this dreadful rank are seen men, whose body is longitudinally transpierced by a stake, some dead, others expiring, some smoking their pipe with as much *sang-*

froid as if they were sitting on cushions, railing at the Europeans, and living, as long as twenty four hours, in the most excruciating torments." North Lat. 35° 28′, East Long. 24° 15′. See Olivier's *Travels in the Ottoman Empire*, vol. ii. p. 288; Sonnini's *Travels in Greece and Turkey*, p. 211; and Savary's *Letters on Greece*, p. 307. (*p*)

CANELLA, a genus of plants of the class Dodecandria, and order Monogynia. See BOTANY, p. 218.

CANEPHORA, or CANEPHORUS, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 144.

CANICULAR YEAR. See CHRONOLOGY.

CANIS MAJOR, the name of a constellation in the southern hemisphere. In Ptolemy's catalogue, it contains 29 stars; in Tycho's, 13; in Hevelius's, 21; in the Britannic catalogue, 31; and in the catalogue printed in the Article ASTRONOMY, we have given the position of 24 of the principal stars. (*w*)

CANIS MINOR, the name of a constellation in the southern hemisphere. In Ptolemy's Catalogue, it contains 2 stars; in Tycho's 5; in Hevelius's 13; in the Britannic catalogue, 14; and in the catalogue printed in the article ASTRONOMY, we have given the longitude and latitude of 8 of the principal stars. (*w*)

CANNA, a genus of plants of the class Monandria, and order Monogynia. See BOTANY, p. 77.

CANNABIS, a genus of plants of the class Diœcia, and order Pentandria. See BOTANY, p. 329.

CANNÆ, in ancient geography, a small town of Italy, situated on the river Aufidus in Apulia, not far from the sea. The traces of Cannæ are at present very faint, consisting of a few fragments of walls, gates, and altars, with some excavations. Even the river seems to have degenerated from its ancient grandeur,—its sounding stream, so much celebrated by the poets, being, when visited by Swinburne, but a tame muddy rivulet. The embankments, however, by which its encroachments are restrained, sufficiently attest its force in winter, when it is swelled by the mountain torrents. Cannæ is chiefly remarkable for the battle fought in its vicinity, between Hannibal and the Romans in the second Punic war. This great engagement, which nearly annihilated the power of Rome, and which, in that case, would have totally altered the destinies of the world, was fought in the year of Rome 536, before the Christian æra 216.

After the battles of Trebia and Trasimenus, in which the flower of the Romans perished, nothing short of madness could have prompted the senate and people to oppose to the victorious veterans of Hannibal their raw tumultuary levies, however numerous and brave. Fabius Maximus accordingly adopted the wise policy of protracting the war; and contenting himself with a moderate number of troops, took care never to lose sight of the enemy, but at the same time not to come to a regular engagement. By this mode of warfare, the only one that has ever been successful in similar circumstances, the Carthagenians, in an enemy's country, were speedily thinned by the sword, famine, and disease. In proportion as the Romans increased in numbers and experience, the invading army was diminished and disheartened; and so nearly was Hannibal worn out by this plan, that his mercenaries were on the point of deserting, and he himself entertained the project of escaping into Gaul with his cavalry alone. But his affairs were destined soon to be retrieved by the foolish impatience of the Roman populace. A few successful encounters, hazarded contrary to the injunctions of Fabius, raised the spirits of the giddy rabble to such a pitch of frenzy, that they now began to impeach the courage and even integrity of Fabius, to demand a new system of war, and to look out for generals of a more enterprising description. Even the senate became infected with these sentiments; and though they made some opposition to the election of Varro, a headstrong fiery character, and gave him for his colleague Paulus Æmilius, a man of the same description as Fabius, they undeniably empowered these two consuls to seek the enemy, and bring the war to the issue of a general engagement. The preparations made for this event were such as Rome had never before witnessed. Each of the four veteran legions already in the field, was recruited to the strength of 5000 foot, and 300 horse. In addition to these, four entirely new legions were organised, consisting of the same number as the former; and the whole being joined by an equal number of auxiliary foot, and twice the number of horse, a magnificent armament was thus quickly formed of about 88,000 combatants, of whom 7200 were cavalry. Hannibal's army was only 50,000 strong, composed chiefly of Gauls and Spaniards; but of these, 10,000 were cavalry in the highest state of discipline. This superiority of the Romans in point of numbers was more than counterbalanced by the inexperience of their troops, and by the opposite dispositions and unbecoming quarrels of the two consuls. Varro, all eagerness for engaging, and Æmilius, attached to the Fabian system, soon found it utterly impossible to carry on a joint command. From a partition of the troops, they were imperiously deterred by the recent disastrous example of Fabius and Minucius: they therefore resolved on the equally dangerous expedient of taking the supreme command each his day alternately.

When the two consuls came up with Hannibal, whom they had followed from the north, they found him encamped near the village of Cannæ, but on which side of the Aufidus is uncertain. Their first care, as usual, was to fortify a camp, which they pitched not far from Hannibal's, on the same side of the river; and to secure a free communication with the opposite bank, they pushed across a strong detachment, who fortified themselves in a lesser camp on the other side. It is probable, however, that the river was at this season, which was summer, easily fordable in most places, and that it presented no other obstacles than those arising from a rugged channel and steep banks. To Hannibal, who was apprised of every transaction within the Roman camp, the consular dissensions augured well; and on the hot temper of Varro he resolved to practice some of his old artifices. With this view, he ostentatiously offered battle, insulted the enemy by every means in his power, and while he thus encouraged his own troops, who were at first terrified by the amazing numbers of the Romans, he succeeded in bringing on, what was necessary to him in his present embarrassed circumstances, a general engagement. By a trivial event, he completely exhausted the patience of Varro; for after having repeatedly insulted the greater camp of the Romans, he despatched a party of Numidian horse across the river, who falling suddenly on the watering parties of the lesser camp, drove them with great slaughter before them, and advanced to the very ramparts. Had Æmilius not happened to have the command this day, Varro would have crossed the river instantly to revenge the affront; but this measure he was compelled to put off for a few hours longer, by the authority of his colleague, who was entirely averse to a general action.

Next morning's dawn discovered to the eyes of both armies the red flag, the signal for battle, flying over the tent of Varro; who immediately after conducted his forces across the Aufidus, and joined them to those from the lesser camp. Æmilius, seeing now that all opposition was fruitless, accompanied Varro to the field, and, like a faithful soldier, seconded all his measures. The reasons which determined Varro to this movement with his main body, seem to have been both the desire of a position better adapted for his infantry, in which his chief strength lay, and the consideration, that on that side Hannibal had no camp to which he could retire in case of a defeat. The whole Roman army, with the exception of those left to guard the two camps, being now united, was drawn up by the consuls in the following array. In the right wing were posted the knights, the flower of the Roman cavalry, having their right flank protected by the river, and their faces turned to the south. Next came the legions, drawn up, on this occasion, in one very deep compact line, on account of the smallness of the space for such a multitude, and probably the better to resist the shock of cavalry. On the left of the legions were drawn up in similar array, the whole body of the allies, having their own numerous cavalry posted on their left, who terminated, on that hand, the general line. An advance or first line was composed of the light infantry, armed with bows, slings, and javelins. The two consuls commanded the wings, Æmilius the right, and Varro the left, and to Servilius, a consul of the preceding year, was committed the conduct of the centre.

During these proceedings among the Romans, Hannibal was not idle. As soon as he discovered their intention, he hastened to meet them beyond the Aufidus, on the ground which they themselves had chosen for the field of battle. Sending over his Balearic slingers and other light troops before him at break of day, to cover his passage, he himself soon followed at the head of his regular forces, which were conducted into the field according to their intended stations. While his men were coming up, Hannibal rode forward to an eminence with a few attendants, in order to reconnoitre the enemy, whom he found already ranged in order of battle. Gisco, a Carthaginian nobleman, observed to him, with symptoms of alarm, that the number of the enemy was very astonishing; Hannibal, with a serious countenance, told him, that there was something yet more astonishing; "for," said he, "in all that immense army, there is not one man whose name is Gisco!" This unexpected jest made all the company laugh, and soon produced a similar effect through all the army, who, by this well-timed pleasantry of their general, were at once relieved from all their apprehensions.

The disposition of Hannibal's army was regulated, in a great measure, by the arrangement of the enemy. On the left extremity of his line, and nearest the river, were posted the Gaulish and Spanish cavalry, as being best calculated to cope with the Roman horse; on the right extremity were the Numidian cavalry, excellent in pursuit, though not firm enough for a shock, but altogether proper antagonists to the social cavalry of the Romans. Between these two wings extended his main line of infantry, which was so arranged, that the African foot, who were heavy armed, composed both its extremities; while the Spanish and Gaulish infantry, who were not so regularly armed, occupied the centre. The light troops were a little in advance, before the main battle. By this disposition Hannibal had two objects in view; to oppose corresponding descriptions of force to the Roman line, and to break down and intermix his various nations, so as to make them a check upon each other. Having assigned the left wing to Hasdrubal, and the right to Maharbal, he himself, with his brother Mago, commanded the centre. Livy affords us a most lively view of this various assemblage of nations, when drawn up in line, and ready for battle. The Africans, he tells us, might well have been mistaken for a Roman army, being equipped with the armour of the Romans, vanquished in the battles of Trebia and Trasimenus. The shields borne by the Gauls and the Spaniards were nearly of the same form; but the swords of these nations were dissimilar. The swords of the Gauls, like those of our own ancestors the Caledonians, were excessively long, and without point; while those of the Spaniards, who were accustomed more to thrusting than to cutting, were remarkable for their shortness and their sharp points. The general appearance of these two nations, conspicuous for the gigantic size of their bodies, and their barbarous aspect, was terrible to the view. The Gauls were naked from the waist upwards; the Spaniards were dressed in linen habits of a surprising whiteness, the effect of which was magnificently increased by a rich border of purple.

In the direction of his line, as well as in the choice of his ground, Hannibal was evidently compelled, in some degree, to conform to the arrangements of Varro, who had first taken his station in the field. This being the case, the left of the Carthaginians touched the river, their line ran parallel to that of the Romans, and their faces were turned to the north, independently of the foresight of Hannibal, who yet is mentioned by Plutarch as having drawn up his men, so as to have the wind Vulturnus to their back, while that hot and suffocating wind blew clouds of dust into the eyes of the Romans. The meridian sun, and the wind Vulturnus, were indeed in his favour; but the merit was not his, for Varro, who had overlooked and probably despised these advantages, had forced them unavoidably upon his antagonist. Some difficulties have been started by Chaupy, respecting what quarter the armies faced, founded on topographical considerations, and the direction taken by the fugitives after the battle. But it is abundantly obvious, that a rapid stream flowing through a sandy plain, and restrained at present from changing its course only by moles and embankments, must have occasioned, in the space of 2000 years, many alterations in the aspect of the vicinity; and also that in a tumultuary engagement, bodies of men may escape in all directions. In our opinion, the expression of Polybius is no more equivocal than that of Livy. As the Aufidus runs generally in a north-easterly direction, we must suppose such a large elbow as Swinburne observed in the vicinity of Cannæ, in order to make the armies, while their faces are turned respectively to the north and south, to have each of them an extremity resting on the river. But the supposition of that traveller is altogether inadmissible, that Hannibal, after fording the stream, drew up his men within the bending of the river in front of the Romans, his troops forming the chord, of which the river in his rear was the arch. In this case Hannibal would have had both his wings resting on the river, a circumstance never before heard of; and his danger, in the estimation of every military man, must have been prodigiously increased by his entangled position.

Both armies being drawn up as we have described them, the light troops on either side raising, as usual, a great shout, began the battle. Soon afterwards, Hannibal ordered his Spanish and Gaulish horse, the best in his army, and stationed as already mentioned on his left wing, to attack the Roman knights. This terrible conflict, as Livy observes, was not in the usual style of equestrian engagements ; for confined on one side by the river, and on the other by the infantry, the horsemen were compelled to rush straight forward against each other, and to fight man to man ; and when the horses were so crowded and intermixed that they could scarcely move, the soldiers pulled each other from their seats, and continued the action on foot. The veteran horsemen of Hannibal at last prevailed. Most of the knights were slain upon the spot, and the remainder pursued and dissipated by Hasdrubal. This general immediately wheeled round to the right wing, routed in a short time the cavalry of the Roman allies, and dispatched the Numidian horse in pursuit.

While this awful prelude was going on, the regular infantry on both sides drew near to try their strength. The Romans seem to have received the onset, and to have continued with one straight front till actually engaged. But Hannibal ordering his heavy-armed Africans, who composed the extremities of his infantry, to stand still, moved forward in person at the head of the main body, composed of the Gaulish and Spanish infantry. The centre of this body was considerably advanced beyond its flanks, which however still rested, like the extremities of a great arch, on the heavy-armed Africans. The great superiority of the Romans, who were nearly double his numbers, had obliged Hannibal to extend, and consequently to weaken his infantry. This weakening, however, of his line, we have reason to believe, was confined exclusively to the prominent part of it in the centre, the Africans being firm and compact in their array. It was the singular glory of Hannibal on this occasion, to have converted his deficiency of strength into the cause of victory. Well aware that his barbarous auxiliaries, arranged in a thin line, could not long withstand a regular shock of heavy-armed infantry, his intention was most clearly, from the beginning, to encourage the Romans to break through his centre, and thus expose themselves on their flanks. Accordingly, after the advanced Gauls and Spaniards had fought most desperately for some time, they began at last to give way ; and this body, which originally presented a convex line to the enemy, was now bent in the contrary direction, and embraced the advancing Romans in the form of a half moon. These, thinking to overwhelm Hannibal at once, pushed on with irresistible fury, and drove him before them with shouts of victory. Varro and Æmilius appear to have been carried along with the soldiery by the blindest presumption ; for instead of securing their flanks, and overturning the Africans in their course, they seem to have concentrated their troops, for the purpose of entirely breaking through the enemy, and attacking him in the rear. This movement proved fatal to the Romans. The Africans, who had hitherto stood still, were now closing on the Roman flank, while Hasdrubal and his victorious cavalry was ready to fall upon their rear. Vigorously attacked on both sides, the consuls made their men face different ways ; but the contest was no longer equal, the Africans were quite fresh and in order,—the Romans, already exhausted with fatigue, were also in the utmost confusion. The return of Hannibal with his Gauls and Spaniards, whom he had soon rallied, made it no longer a battle, but a carnage. Fighting hitherto with the greatest bravery, and performing all that could be expected from high spirited men, the Romans were now at length utterly broken and routed. The Carthaginian cavalry, in which arm Hannibal was stronger, acting on a plain, and in the midst of a disorderly crowd of flying enemies, allowed few to escape ; while the infantry, in like manner, exasperated by their fatigues and their habitual enmity, revelled with savage eagerness in the work of destruction. Hannibal himself was at last so much touched with compassion at the fate of the Romans, that he cried out several times during the slaughter, " Hold, soldiers ! spare the vanquished !"

The fate of the consul, Paulus Æmilius, as described by the ancient writers, is truly affecting. This brave captain had been severely wounded early in the day ; but his zeal would not suffer him to quit the field till most of his troops were cut to pieces. At this last extremity, in the hopes of retarding the pursuit, he ordered the few cavalry who still kept by him to dismount, and engage the enemy on foot. This slender band, however, was soon overwhelmed by the impetuous enemy, and every man who was able mounted his horse and fled. During this melancholy exigency, Cneus Lentulus, a legionary tribune, happening to ride that way in his retreat, espied the consul sitting on a stone, and covered all over with wounds and blood. The generous tribune immediately offered him his horse, observing that he could help him to mount, and protect him. But Æmilius, with an air of grandeur, declining his offer, advised him to make use of his small time for escaping, expressing, for his own part, his fixed resolution to expire on those heaps of his dead soldiers, by whom he was surrounded. He, at the same time, enjoined the tribune to advise the senate to fortify Rome with all speed, and to assure Fabius that he had lived, and was now dying, impressed with the wisdom of his counsels. Before Lentulus had gone far, he observed, with the keenest anguish, the noble consul surrounded, and still feebly fighting in the midst of the enemy, who were not then aware of his quality. The other consul, Varro, escaped to Venusia, attended only by seventy horse.

This was perhaps the greatest defeat that the Romans ever experienced, not excepting that from the Gauls. Of an army of near 90,000 men, not more than 4000 escaped directly from the battle : some thousands more of those who had guarded or reached the camps, availed themselves of the darkness and confusion of the following night, to reach Canusium, a strong fortress in the neighbourhood. Besides the consul Æmilius, two quæstors, and one-and-twenty legionary tribunes, there fell, on this fatal day, Servilius, the third in command, Minucius, consul and general of the horse under Fabius, fourscore senators, who had volunteered their services, and such a prodigious number of knights, that of the rings which they wore as the badge of their order, three bushels were sent to Carthage. Polybius makes the general loss amount to 70,000, though Livy reduces it to 50,000. The loss of Hannibal was comparatively trifling, consisting only of 4000 Gauls, 1500 Spaniards and Africans, and 200 horses.

Having allowed his troops the whole of that night for the purpose of repose, he employed the next morning in going over the field of battle, and gathering the spoils. The scene was horrible beyond description, even to the Carthaginians themselves. In the course of the day, he besieged the two camps, which were still defended by about 10,000 men, chiefly wounded, who almost immediately surrendered by capitulation. It is difficult to assign the true reason, which had deterred this matchless general from making an attempt on Rome immediately after his tremendous victory. But having consumed some days in the neighbourhood of Cannæ, the favourable opportunity was lost for ever. The consul Varro was already posted at Canusium, with the wreck of his army, now accumulated to 10,000 men; the senate and people of Rome, after the first transports of terror were over, now spoke more loftily than ever; the city was put in a formidable state of defence, and assistance hastening from all quarters; and with a force of less than 30,000 infantry, destitute of magazines, machines, and other necessaries of war, Hannibal could not pretend to besiege a city in form, which still contained more soldiers than he had under his command. His subsequent feeble attempts on some small towns, demonstrate incontrovertibly the insufficiency of his means for undertaking the siege of Rome at this period. The battle of Cannæ, however, though not involving in its consequences the immediate destruction of Rome, was notwithstanding highly beneficial to the Carthaginian cause. He, who before that great event was a mere fugitive in an enemy's country, having neither town, post, nor magazine in his possession, saw himself now all at once master of the greater part of Italy. The most faithful allies of the Romans began now to stagger in their allegiance, considering Rome as at an end; and a long catalogue of the Italian nations declared for Hannibal. See *Polyb.* l. iii. Liv. xxii.; *Plut. in Fab.*; Rollin's *Rom. Hist.* l. xiv.; and Swinburne's *Travels in the Two Sicilies.* (E)

CANNIBALS, is an appellation given to those savages who feed on human flesh.

Much incredulity has been displayed concerning the existence of men who could devour their own species, and the fact has been considered so abhorrent to the laws of nature, so offensive to the Deity, and so improbable in itself, that the possibility of it has been keenly denied. It has been maintained also, that loathsome diseases would be generated by feeding on human flesh, and that inevitable destruction would follow; for such were the consequences of compelling animals of the same tribe to subsist on each other, that they either became ferociously mad, or wasted away and died. Yet it must be admitted, that the opinions of those who have argued in this manner have resulted, more from their aversion to credit such an atrocity, as degrading to mankind, the chosen work of the Creator, than from philosophical considerations. Authentic history, and present experience, equally prove, that there are not only cruel and sanguinary races of cannibals, but that, even among the more civilized part of mankind, individuals repeatedly resort to banquets of human flesh, in situations of extreme necessity.

A belief in the existence of cannibals has prevailed in all ages of the world; and, in the writings of the ancients, we find whole tribes, or nations, characterised as *men eaters.* Herodotus, Mela, Strabo, and Pliny, speak of such, either from their own knowledge, or the report of others, and describe the particular regions in which they dwelt. Herodotus, who is entitled to the greatest credit, from the extent of his travels, the accuracy of his observations, and especially because the modern investigations of his geography have given it corroboration, alludes to a nation, apparently in India, called *Callatiæ*, or *Callantiæ*, who regularly killed the more aged among themselves, and devoured their bodies. The ancient Scythians, also, by almost universal concurrence, seem to have been considered cannibals; and Strabo, on the authority of Ephorus, relates, that they ate human flesh, though they abstained from that of animals.

Herodotus speaks of an adjoining tribe, seperate and distinct from the Scythians, using a peculiar language of their own, but wearing similar apparel, who were the rudest of mankind. They led a rural life, obeyed no laws, acknowledged no superiority, and fed on human flesh. Such national characteristics must be viewed as different from those accidental circumstances, which, from temporary revenge, or necessity, have induced mankind to devour their own species. The Jews, in the time of Trajan, for example, are stated to have exercised unheard of cruelties; they are said to have killed 40,000 men in Egypt, Cyrene, and Cyprus; to have fed on their flesh, besmeared their faces with their blood, and clothed themselves in their skins: yet they do not come under the denomination of cannibals.

In Europe, however, there are strong indications of their existence, long subsequent to the Christian æra. St Jerome, in his writings against Jovinian, plainly declares, that it was the custom of some of the British tribes, or those from Britain in another country, to feed on their own species. Though his description of the people is not void of obscurity, his words can admit of no doubt. "Why should I refer to other nations, when I myself, while a youth in Gaul, have seen the *Atticotti*, a British tribe, eating human flesh? Should they find shepherds tending their herds of swine, or cattle, and flocks of sheep in the woods, they are wont to cut off the fleshy parts of the men, and the breasts of the women, which are esteemed the most delicious food." St Jerome lived in the fourth century. But to descend still lower, we find traces of the same barbarous custom in Scotland, at a far later period. During a war with England, the "men of Galloway" committed the most horrible atrocities. They not only slaughtered the innocent, without distinction of sex or age; but they cut out the bowels, devoured the flesh, and drank the blood of their victims mixed with water. Their ravages were carried far into the country, until the invaders were met, and defeated at the battle of the Standard in 1138.

Perhaps this is the last instance of such savage barbarity known in Europe; and here we can trace the customs of the Scythians, from whom the inhabitants of these kingdoms are by many believed to have sprung. The Scythians drank the blood of their enemies, and made drinking cups of their skulls. There was a certain festival at which none could drink who had not killed an enemy; and it at length became connected with religious rites, as well as being a token of conquest. Livy relates, that the Boii, availing themselves of a victory which they had gained, cut off the head of the Roman general Postumius, and having set his skull in gold, deposited it in a temple for consecrated libations. It can scarcely be doubted, therefore, that in former years cannibals were known in Europe, and it is probable that the tribes of Britain may be ranked among the number.

This sanguinary and repulsive custom has, for centuries, been confined to the African and American continents; for we do not know, with certainty, that it has been found in Asia, strictly so denominated. Though many have been inclined to consider the narratives of the earlier European navigators to America as in this respect fabulous, cannibals were recognised there from the time of Christopher Columbus. Intelligent observers, who resorted thither, either for a permanent or temporary residence, about the middle of the sixteenth century, have detailed the whole of the barbarous ceremony, and with such intrinsic evidence, that we cannot reject their testimony. It does not appear, however, that human flesh was an ordinary means of subsistence; on the contrary, the enemies taken in open hostility, or by stratagem, were alone sacrificed by the victors. Many superstitious ceremonies were practised on the occasion; the victim was reserved until a certain time, sometimes remote from the period of his capture; and, in the mean time, he was copiously fed, and allowed sufficient exercise. As his fate approached, his face and body were painted with mystic lineaments, which were also impressed on the club that was to give the fatal blow. He was confined the night previous to execution in a hut specially built for the purpose, which, after his removal, early next morning, was thrown down. But these preparations, and others which followed, were insufficient to inspire him with the fear of death: he continued to congratulate himself on the mischiefs which he had already been enabled to inflict on his enemies, boasted of the prowess of his nation, and foretold the vengeance that they would take for his death. He beheld, without emotion, the fire, and the surrounding hordes invited to partake of the bloody repast, and stood undaunted to receive the blow which was to terminate his existence.

In the feast which followed, we find a lively picture of the descriptions contained in Homer; and if that poet had lived subsequent to the days of Herodotus, we could, under some modifications, have traced them to the historical truths which he records. The poetical fictions which are employed to embellish the adventures of Ulysses are also founded on the general belief of the times. The body of the victim being carefully washed and skinned, was cut into quarters, and the flesh was immediately devoured, roasted or half boiled, amidst savage rejoicings. Here, the women acted as conspicuous a part as the men; they were employed in the mystic ceremonies, and they witnessed the execution, and participated in the banquet with equal indifference. When it was their misfortune to suffer, they shewed the same fortitude that was exhibited by warriors. John Lery relates an instance that came under his own notice, of advising a woman, who was about to be massacred, to pray to heaven; she replied that it was unnecessary, and that she laboured under no apprehension of death.

The same custom has been practised down to the present day, though it is now greatly declining. Father Hennepin, and M. Laborde, observe, that the Caraibs were cannibals when visited by them in the latter part of the seventeenth century; and that they frequently carried the hand and foot of a slaughtered enemy along with them. M. de Belleisle, a French officer, was taken prisoner, in 1719, by the Atakapas, a tribe near the Gulf of Mexico, who fed on human flesh. As he displayed the utmost repugnance to this practice, they deceived him into a participation of their repast, which was common at that time, but which is now altogether eradicated from among their descendants. That the South Sea islanders were cannibals during the voyages of discovery from this country, is attested by Captain Cook; and there is some reason to believe that the body of that celebrated navigator was devoured at Owhyhee. Such was unquestionably the fate of one of his cotemporaries, M. Marion de Fresne, who had been sent out from France with a native of Otaheite, brought over by M. Bougainville. Having reached the bay of islands in New Zealand, he entered into an amicable correspondence with the natives and their chiefs. Mutual civilities were unremittingly interchanged during the 33 days that he lay at anchor on the coast; the natives slept on board of his vessel; and the seamen, after wandering about on shore in safety, or penetrating the interior, were regularly conducted to the beach by the islanders. At length, M. de Fresne, accompanied by 17 people, embarked in his long boat, and was received on shore with the accustomed demonstrations of friendship. But while resting in perfect security, and when all his party, unsuspicious of treachery, had separated, they were suddenly attacked by the natives, and the whole, except a single seaman, were inhumanly massacred. The unhappy victims were immediately ripped up, cut into quarters, and distributed among the ferocious assailants, in sight of their comrades, who lay concealed among some brush-wood during the tragical scene. The French were not slow in avenging the death of the sufferers: they landed in force, and proceeded to the principal village, from which the inhabitants fled on their approach; but there they obtained too conclusive evidence of what had passed. In the hut of the chief was found a human skull, of which some remaining flesh still bore the marks of the teeth of the cannibals; part of a human thigh was also seen on a wooden spit, about three-fourths of which had been devoured; and human entrails, which are said to be considered a delicacy, appeared ready cooked. The village of these barbarians was then reduced to ashes, and their canoes also burnt.

It was known, indeed, before this period, that the New Zealanders were cannibals. They had acknowledged to Captain Cook that they devoured their enemies, but considerable incredulity respecting it prevailed. They had also admitted to Mr Savage, who visited them in 1805, that in times of scarcity they had been obliged to eat human flesh; yet their manners were more favourably viewed than they merited, as has been recently exemplified by another catastrophe like the preceding. A British ship repaired to New Zealand in 1809, for the purpose of purchasing timber, and an amicable correspondence, as before, was entered into with a chief. He was received on board with great respect; and, on one occasion, the captain, accompanied by part of the ship's company, attended him on shore. The chief soon returned, and when those who were necessarily occupied in the vessel least suspected treachery, he gave a sudden yell, upon which his companions immediately began to massacre the unfortunate crew. Ten or twelve who had precipitately ascended the rigging on the first appearance of danger, were deluded by promises of safety to come down; yet, on reaching the deck, they also were cruelly butchered. The captain and his companions had been previously dispatched by the natives on shore; and, of the whole, no more were preserved, than a woman, two girls, and a boy, who some time afterwards were rescued. Thirty or forty men thus fell a sacrifice to the savages, and their bodies were devoured. These, among other instances, forcibly prove that savages can never be trusted; that they are all cruel and ferocious; and that they only wait for the moment when their superiority may prevail over the unsuspecting victims.

The natives of New Caledonia have been represented by some voyagers, considering them in their most pacific state, as a race endowed with gentleness and docility. Yet experience proves that they are cannibals to as great an extent as the New Zealanders. They were seen by the navigators sent out in search of La Perouse, in 1793, devouring human flesh; and a portion roasted, which proved to have belonged to a young person of 14 or 15 years of age, was offered to one of their number. The natives acknowledged that they relished such an exquisite feast, and with their teeth greedily tore the remaining sinews and ligaments from a bone. A skeleton, bearing the marks of fire, hung from a post beside the door of a hut, which was found to be the remains of an unfortunate wretch who had been devoured. The natives explained, in an unequivocal way, how they proceeded to a repast on the bodies of their enemies; and maintained, that these were the only victims whom they devoured. After the victim fell under repeated strokes of a club or javelin, the belly was ripped up with an implement made of a hard sharp-edged stone, specially adapted for the purpose; and then, with another implement of human bone, also prepared for the occasion, the entrails were drawn out. The legs and arms being next severed at the joints, were distributed among the combatants, to be carried home as food for their families. The muscular portions of these members were esteemed particularly delicate; and, indeed, the same cannibals grasped the fleshy parts of their visitors with an eagerness and avidity, clearly demonstrating the gratification which they should enjoy from making a meal of it.

It is possible that the continual wars, in which petty states or inconsiderable islands are involved, may render the inhabitants more ferocious; for all human passions only lurk in concealment, and are ready to be excited into action. During a war in Tongataboo, in the year 1799, independent of devouring the dead bodies, the women were seen, after a battle, licking their hands which had been dipped in the blood of the slain. In those which have been called the *Friendly Islands*, the natives are as savage as in those islands where warfare is known to prevail without intermission: whence, it is to be concluded, that cannibal practices are far more widely diffused than has hitherto been supposed.

Nearly about the same period that the catastrophe above related, happened to the British vessel at New Zealand, a scene as sanguinary and horrific was passing at the Fejee islands. Several Englishmen at that time being taken prisoners by a warlike chief, who aimed at conquering all the neighbouring territories, were retained to witness the progress of his arms. An immense fleet of canoes sailed from his principal residence, and was met by one brought out by his opponents to guard their island; but after a long and obstinate conflict, the latter, overpowered by numbers, forsook their vessels, and leaping into the sea, escaped by swimming ashore. Only one boy was taken, who, being presented to the relentless savage, was dispatched by three blows of a club, and his body given in charge to an attendant, to be roasted for him. But this did not satisfy his vengeance; he resolved to extirpate his enemies, by massacreing the helpless women and children, who could not accompany their husbands and fathers in their flight. A shocking carnage ensued, wherein all were butchered on the spot by the furious assailants, without distinction of age or sex, or were dragged half dead into the canoes, where they breathed their last. When the cruel object was completed, no less than 42 corpses were extended on the platform of the canoe which the chief commanded, and delight was pictured in every countenance at the horrible banquet which was to follow. The body of a young female principally attracting his attention, he ordered it to be laid aside for himself and his second in command: a fact which coincides with what is told of some barbarous leader, who, on a march, always carried young women along with him, who were occasionally sacrificed for his food. The dead bodies were accordingly conveyed home with the invaders, and deprived of the limbs, which were hung up on trees, and ready to be cooked. Twenty or thirty men afterwards appeared with baskets full of human flesh, half roasted, which is the method adopted for preserving it, and the English were urged to partake in the succeeding repast.

The ancient and modern existence of cannibals is, therefore, too satisfactorily proved, ever to be again called in question.

It is difficult to account for the origin of so barbarous a practice as that of devouring human flesh, though men may be conducted to it by imperceptible gradations. Those tribes which are of the rudest manners, and sunk lowest in the scale of civilization, can scarcely be accused of participating in it; for the cannibals presently known are rather nations verging towards improvement, and animated by the desire of conquest.

Feeding on human flesh may have resulted either from necessity, or from some religious ceremonial; and it may gradually have been adopted as a token of personal prowess. Where the culture of the soil is neglected, and a scanty sustenance precariously obtained, mankind are exposed to long and severe privations. To quell the cravings of hunger, tight ligatures are bound around the body, and lumps of unctuous earth greedily swallowed. If an animal be killed, its blood is drank, and its flesh is devoured raw; and the meal is repeated as often as occasion will allow. Under the pressure of necessity, therefore, while the savage makes a necklace of the teeth of his fallen enemy, or ornaments himself with his bones, it is less unnatural that he should at once give an unquestionable proof of his prowess, and satisfy the cravings of nature, in making a repast on his flesh. From some principle of religion or duty, it is well known, that certain tribes expose their aged relatives, or those labouring under incurable disease, to inevitable death. They are said, as we have already seen, to have fed on them of old; and there is still a tribe dwelling on the island of Sumatra, who, from a religious rite, devour the flesh of their kindred. Human sacrifices are yet offered up to the deities of savage nations; portions of the flesh are presented; and libations of the blood are raised to the lips of the bystanders.

It is not long since the Araucanians sacrificed a captive to the manes of their deceased countrymen after a battle. The victorious chief gave the victim a mortal blow; his heart was instantly cut out by two attendants, and some of the blood sucked by the same chief, who passed it along to the principal warriors, that they might follow his example.

Though a banquet of human flesh be horrible and repugnant to those who have never felt the pressure of necessity, it is too well known that hunger obliterates every sentiment but the desire of self-preservation; nay, in cases of extremity, it becomes the primary object among men, that some one of a number shall suffer death, that his body may be the means of supporting the rest. Of this, several deplorable instances have been witnessed in sieges and distresses at sea. During the former, soldiers have sustained themselves on the bodies of their fallen comrades; as in that of Sancerre, in 1572, where parents even fed on the bodies of their deceased children. Cases of the latter are more general, from unexpected circumstances, and the difficulty of providing against accidents, where no resource is to be obtained. Confining ourselves to instances of modern date, it may be observed, that the Nottingham, an English vessel, was wrecked, in 1710, on a rock called Boon Island, on the coast of America. This happened in the depth of winter; the place was utterly desert; and, in a short time, two of the crew perished of want. The body of one was committed to the waves; but the strength of the miserable survivors being inadequate to remove the other entire to a distance, whenever it was dragged without the tent which sheltered them, they began to appease their hunger on the raw flesh, for they were destitute of fire. Thus they subsisted, until they were discovered by strangers. In another vessel, which endured dreadful sufferings from famine at sea, in the year 1765, a negro on board was shot, and his flesh broiled, to supply the necessities of the seamen. But this being all exhausted, it became necessary that one of the crew should die by lot; and accordingly the victim was preparing for his latter end, when a ship came in sight. In 1797, the slaves of a ship from the coast of Africa having risen upon the crew, their only chance of escape was by leaping into the boat and cutting her adrift. Twelve in this manner were saved; who, after eating every thing they could swallow, including their shoes, were obliged to resort to the dreadful expedient of devouring each other. At length, having cast lots, the first victim resolutely resigned his life, only requesting to be bled to death, which the surgeon, who had his case of instruments about him on quitting the vessel, proceeded to do. But no sooner had he touched the vein, than he applied his lips to drink the blood as it flowed, and his companions quickly made a repast on the flesh. Yet, from immoderate indulgence, it did not contribute to their general preservation, for only three survived when the boat drifted ashore at Barbadoes, on the thirty-eighth day after they had left the ship. A similar calamity occurred, and the same resourses were employed, in 1799, by six men who had lost their course in a boat from St Helena. Being nearly a month at sea, and having suffered incredible distress from hunger and thirst, four of the number proposed to sink the boat, that an end might be put to their misery. But this being objected to, they agreed to cast lots which should be slain for the subsistence of the rest, and that the person on whom the lot fell should bleed himself to death. Accordingly one who, being sick of a scarlet fever, was exempted, formed the lots; and he by whom the fatal one was drawn cut his veins in three different places, the wrist, foot, and hand. Praying forgiveness of heaven, he died in about a quarter of an hour. The others supported themselves on his flesh, until they reached the coast of South America. So lately as the year 1807, when the Nautilus sloop of war was wrecked on a barren rock in the Mediterranean, and most of the crew dashed to pieces or drowned, the body of one was resorted to for the preservation of the survivors. Numerous other instances might be quoted, which clearly illustrate that the repugnance naturally excited amidst abundance may be conquered under the pressure of necessity: nor has it ever been remarked that human flesh is unpalatable food.

But there is one most singular fact invariably concomitant on indulging this cannibal appetite, which is well deserving of consideration. It is uniformly attested by persons in opposite parts of the globe, under various climates, in different circumstances, and where they could have no knowledge of each other's experience, that an uncommon degree of ferocity is speedily generated by feeding on human flesh. A more forcible picture can scarcely be drawn than in the words of the commander of a vessel cast away on a desert shore, whose crew were compelled to adopt such means to preserve their miserable lives. "In a few days I found their very natural dispositions changed, and that affectionate peaceable temper they had hitherto displayed altogether lost. Their eyes were wild and staring, their countenances fierce and barbarous, and, instead of obeying my commands, as they had universally and readily done before, I found that all I could say, and even prayers and entreaties, were fruitless. Nothing was now to be heard but brutish quarrels, supplanting that quiet submissive spirit of prayer and supplication which we had hitherto enjoyed." Yet it is not to be denied, that hunger in itself also renders men ferocious: it enfeebles their minds as well as their bodies, their nature is altogether altered, they view each other with a malignant eye, and even feel an insatiable desire to feed on their own excoriated members. But a supply of food, though scantily administered, will quickly restore them to their ordinary condition.

It is thus established, by incontestible evidence, that there are various tribes of cannibals subsisting at this moment; and that it is not unusual for mankind, in cases of extreme necessity, to preserve their life, by devouring the bodies of their fellow-creatures. See *Herodotus*, *Mela*, *Strabo*, *Pliny*, var. loc.; Hieronymus, *Adversus Jovinianum*, lib. ii. *Opera*, tom. iv. part 2.; Ailred *de Bello Standardii.* ap. Twysden; *Scriptores decem.* p. 1138; Lery *Hist. Navigationis in Brasiliam*; Crozet, *Nouveau Voyage de M. M. Marion*, *Duclesmeur*, *et de Surville*; Rossel *Voyage D'Entrecasteaux*, tom. i. p. 337; and Bossu's *Trav. in Louisiana.* (*c*)

CANNON. See GUNNERY.

CANOE, the name given to the boats and vessels of savage tribes. A particular account of the different canoes will be found in the description of the different countries where they are used. (*w*)

CANON-LAW, is that body of law which was at different times, and in different portions, promulgated under the authority of the see of Rome, for regulating the consciences, and fixing the property, as well civil as ecclesiastical, of all the inhabitants of popish Christendom. It is composed partly of the justest principles of equity, and partly of absurd canons and rescripts on the subtlest points of casuistry, and the uncontroulable supremacy of the church over secular authority.

The collected form in which the canon-law now appears, under the title of *Corpus juris canonici*, consists, 1st, Of a selection, called the *Decretum*, of the opinions of the fathers, popes, and church-councils, made by Gratian, a Benedictine monk, about the middle of the twelfth century, in imitation, as it would seem, of the

Roman pandects, which are a selection of the opinions of their most eminent lawyers; 2dly, Of the *Decretalia*, or rescripts of the popes, collected by Gregory IX. sometime after Gratian's collection, and digested into five books; 3dly, Of the other decretals collected by Boniface VIII. called the sixth book of Decretals; 4thly, Of those of Pope Clement V. Pope John XXII. and of certain other popes, called *Extravagantes*, because they are over and besides the six books of the Decretals. All those different collections were revised by Pope Gregory XIII., and published by him as the *Corpus juris canonici*, or body of the canon law.

Before the Reformation, the authority of this body of law was, of course, very great in most countries of Christendom. Some governments, however, especially those of France and England, appear to have always entertained a just spirit of jealousy against its encroaching authority, in matters of civil property; and, unless when the monarch happened to be more than usually bigotted and submissive, their resistance was not unsuccessful. In all other respects it appears, even in these countries, to have had all the authority of law. Since the Reformation, it has gradually fallen into neglect. Even among those nations who still adhere to the Romish persuasion, its authority is for the most part confined to questions of church doctrine and discipline; while, in Protestant countries, it is only listened to as respectable argument on questions of tithes, patronages, and a few other points of ecclesiastical right, and only in so far as not inconsistent with Protestant principles. See *Præfatio Greg. XIII. in Corp. Jur. Canon.*; *Encyc. Methodique*, *Art.* JURISPRUDENCE, *voce*, *Droit Canonique*; *Black. Comm.* &c. (J. B.)

CANOPUS, the name of an ancient city of Egypt, which was situated nearly on the spot where the modern Aboukir now stands. The columns of beautiful granite, which were found among the ruins of this once celebrated city, and the other splendid fragments of its ancient grandeur, have been recently employed by the people of Aboukir for repairing the dikes that shut out the sea. (*w*)

CANOSA, the *Canusium* of the ancients, is a town of Italy, in the kingdom of Naples. The ancient city was situated in a plain between the river Ofanto (the *Aufidus* of the ancients) and the hills, and appears to have occupied a great extent of ground. The fragments of aqueducts, amphitheatres, tombs, baths, military columns, and two triumphal arches, still display the ancient grandeur of Canusium. The modern town stands upon the spot formerly occupied by the old citadel, and contains no buildings that are particularly deserving of notice. The cathedral, or church of Sabinus, which is a Gotnic edifice, and is supposed to have been built in the 6th century, is particularly remarkable for six verde antico columns, which are considered as uncommonly large and fine. Under an octagonal cupola, in a court near the cathedral, is the mausoleum of the Chevalier Bohemund, who is immortalised in Tasso's *Jerusalem Delivered*. Count Stolberg remarks, that the bread of Canosa is still stony, as it was in the time of the Romans, a circumstance which he attributes to the softness of the mill-stones which are employed in grinding it. Number of houses, 300. See Stolberg's *Travels in Germany, Switzerland, Italy, and Sicily*; and Swinburne's *Travels in the Two Sicilies*, vol. ii. p. 321. (*o*)

CANOUGE, or CANOGE, a town of Hindostan, situated about two miles from the banks of the Ganges, and supposed to be the *Palibothra* of the ancients, from the extent, magnificence, and grandeur, which are ascribed to it in the Indian histories. Its walls are said to have been 100 miles in circumference; and, in the sixth century, it is supposed to have contained 30,000 shops in which betel nut was sold, 60,000 bands of musicians, and 3000 jewellers.

There is now only one single street remaining in Canouge, and even this is no indication of the former greatness of the place. A canal, which has been cut from the Ganges, makes a bend towards the town, and brings the water close to the citadel, which is placed upon a steep eminence. No building of any importance now remains, and the brick walls, which do not seem to be very ancient, are hastening to decay. Two mausoleums, of the same magnitude, and of handsome architecture, are erected to two mussulman saints, on an eminence covered with trees, from which there is a fine view of the plain, covered with ruined temples and tombs. "Tamarind trees, and mango topes," says Lord Valentia, "were scattered every where; and the whitened tomb of an English officer, who was drowned here, raised its pointed head above this scene of desolation. On the inside of the tomb were inscribed several names and dates, with quotations not unappropriate. We next visited another tomb on the most lofty point. It consists of a quadrangle and mosque, similar in miniature to the one at Juanpore. Several pillars in the mosque are formed of two pieces, taken from a more ancient building, the rude base of one of which being placed uppermost, serves for a capital. A great many little images were lying under the trees, but they were too much broken to be interesting. In the centre was a well now filled up, where large sums of money are said to be secreted." For nearly eight miles, the mixture of small pieces of brick, and the vestiges of buildings, attest the former extent of this place. East Long. 80° 13′, North Lat. 27° 3′. See Rennel's *Memoir*; Valentia's *Travels*, vol. i. pp. 187, 188; and CIVIL ARCHITECTURE. (π)

CANSIERA, a genus of plants of the class Tetrandria. and order Monogynia. See BOTANY, p. 126.

CANTAL, one of the departments of France, is bounded on the north by the department of the Puy de Dome; on the west by the departments of Correze and Lot; on the south by that of Aveyron; and on the east by those of the Lozere and the higher Loire. This department is in the middle of the mountains of ancient Auvergne, the highest of which, called *Le Plomb de Cantal*, gives name to the department, and is about 1917 metres. or 984 toises, above the level of the sea. The quantity of grain raised in this department is not very great, but the pasturage is excellent, and supports a great quantity of cattle of all kinds. Cheese is one of the most considerable articles of commerce. There are mines of copper, antimony, and pit-coal in the department; and quarries of marble and slate. In the canton of Vic-en-Carladez there is a celebrated mineral spring. The department contains about 5800 square kilometers, or 383 square leagues of 2000 toises. The forests occupy about 29 or 30 hectares, of which two thirds belong to individuals, and the rest to the nation and the communes of the country. The contributions in the year 1806, were 2,038,302 francs. Aurillac is the chief place of the department. Population, 237,224. (*w*)

CANTEEN, the name of a vessel generally made of white-iron or wood, in which soldiers carry their liquor. Wooden canteens are now very common in the British army, and are made of a cylindrical form, 4 inches long, and 7½ inches diameter, so as to hold three pints.

A set of ingenious machines, for the manufacture of canteens, has been erected by Mr George Smart, of Ordnance Wharf, Westminster Bridge, who makes them in great quantities for government. The limits of our work, however, prevent us from giving any account of this machinery, by which Mr Smart has so simplified all the operations, that a good workman, working 14 hours a day, will head and hoop 200 canteens each day. Wainscot, or foreign oak of the best kind, is the wood which is now employed. (*w*)

CANTERBURY, the *Durovernum* of the Romans, is the capital of the county of Kent, and the archiepiscopal see of the primate of all England. It is situated in a fine valley, on the banks of the river Stour, which here forms five or six islands, by dividing itself into different branches. The town of Canterbury is far from being well built, though, during the last 40 years, it has been much altered, and greatly improved in its general appearance. Canterbury was formerly defended by a castle, surrounded with walls, which seem to have been 1¾ of a mile in circumference; but the castle has been destroyed, and only a small part of the walls remains. The average thickness of the wall is from six to seven feet; at regular intervals it was defended with twenty-one square and semicircular fortified towers, and the whole of it was encircled with a deep fosse, 150 yards wide. The entrance to the city was through six fortified gates, and through some smaller openings in the walls, called Postern gates. The principal gates were, West-gate, North-gate, Burgate, St George's gate, Riding-gate, and Wincheap-gate. The first of these, which was the largest, stands on a bridge of two arches, over the river Stour, and consists of a centre, flanked by two lofty round towers, which are occupied as a prison. This gate was built at the expence of Archbishop Sudbury. The place where the North-gate stood forms the principal entrance from the Isle of Thanet. St George's gate, which resembled West-gate, was built about the year 1470. It contained the water reservoirs of the city, and was pulled down in the year 1801. Burgate, which had been rebuilt of brick, with stone coins, in 1475, was demolished a few years before St George's gate. The Riding-gate, which has been recently pulled down, has its place occupied with a modern arch, over which is the terrace walk, which was formed in 1790, upon this part of the city wall.

The ruins of the castle are situated on the south-west side of the city. Its outer walls included an extent of more than four acres. The Keep, which is the only part now remaining, is about 88 feet long, by 80 broad, and the present height of its walls is 50 feet. A large malt-house and other buildings, now occupy a part of the castle-yard; and the north-west division has been used as a depot for military stores.

About 300 yards to the south-east of the castle is a circular artificial mount, included within a salient angle of the city wall. Its name Dane John, or Dungeon Hill, has given rise to the opinion that it was the work of the Danes. In the year 1790, and 1791, the broad and deep ditch which encompassed about two-thirds of its base was filled up, and serpentine walks were cut round its sides. These walks were connected with a terrace 600 yards long, formed on the top of the high rampart within the wall, and additional walks were formed in the adjoining field. The principal of these, which is 1110 feet long, is flanked with a double row of limes, and unites with the terrace walk at each end. On the top of this mount is a stone pillar, erected to the memory of James Simmons, Esq. by whom these improvements were made.

The principal public building at Canterbury is the cathedral, which stands on the north-east part of the city, and which, with the various edifices that belong to it, occupies a very great extent of ground. It contains specimens of the style of architecture of almost every age, from the arrival of the Normans to the time of the dissolution, and is equally remarkable for the magnificence of its general appearance, for the splendour of its architecture, and for the excellence of its monumental sculpture. The general form of this noble pile is that of a double cross, with a circular termination at the east, and two massive towers at the west end; while a third tower, which is more elegant than the other two, rises from the intersection of the nave and the west transept. The whole of it was newly paved with plain Portland stone in the year 1788. The principal parts of the cathedral which are deserving of notice are, the west front, with its large and elegant window between two towers; the south porch, which forms the principal entrance to the cathedral; the chapel of the virgin, which is a fine specimen of the pointed style of architecture; St Michael's chapel; the choir, which is reckoned the most spacious in the kingdom, and is fitted up in a very handsome manner; the chapel of the Holy Trinity, which contained the shrine of Becket, the vestry, the treasury, the audit room, the library, the chapter-house, and the cloisters.

The interior length of the cathedral, from east to west, is 514 feet; the length of the choir 180 feet; the length of the nave to the bottom of the choir steps, 178 feet, and from thence to the screen at the entrance of the choir, 36 feet; the breadth of the choir is 40 feet, the length of the east transept, from north to south, is 154 feet; the length of the west transept, 124 feet; the breadth of the nave and its aisles, 71 feet; the height from the pavement to the vaulting of Trinity chapel, 58 feet: height of the choir, 71 feet; height of the nave, 80 feet; height of the great tower, 130 feet; extreme height of the great tower, 235 feet; height of the south-west tower, 130 feet; height of the north-west tower, 100 feet.

At a little distance from the cathedral, in the eastern part of the city, are the remains of St Augustine's abbey, which was the first Christian establishment in this kingdom. It was founded in 598, and at one period it almost vied in magnificence with the cathedral itself. The precincts of the abbey included a space of about sixteen acres; and the surrounding walls are in a great measure entire. The west front was 250 feet long, with a gate at each extremity, which still remain. St Augustine's gate, which formed the principal entrance, is an elegant building; but it is now much dilapidated, and has been converted into a brewery. The other entrance, called the cemetery gate, has been recently altered into a modern dwelling. The remains of the abbey church afford a beautiful specimen of Norman architecture. The west end, called St Ethelbert's tower, is a lofty and elegant ruin, which displays various ranges of semicircular arches, beautifully ornamented with mouldings and sculpture.

The principal churches in Canterbury, are Holy Cross church, a low but spacious edifice, built in the reign of Richard II.; St Alphage church, a spacious and respectable building containing many sepulchral monuments; St Margaret's; St Andrew's, which was built of brick in the year 1764; St Mary Breding, a small but ancient structure; St Mary Magdalen's church; St Mildred's church, which is spacious and well built; St Dunstan's church, situated on the London road, near the entrance of the city; St Paul's church, which stands without Burgate, in the eastern suburb; and St Martin's church, which stands on a rising ground a little beyond the precincts of St Augustine's abbey.

The town-hall, which was partly rebuilt in forming a new street, is a respectable building, and contains some good portraits. The public assembly rooms, in the high street, were erected by the gentry of East Kent. The ball-room is a spacious and elegant apartment, and beneath it is a public bank. The theatre, which is a handsome building, stands in Orange-street, and was opened in the year 1790. The royal cavalry barracks, built of brick, were erected in 1794, and in 1798 additional barracks for 2000 infantry were constructed. New buildings, for a similar purpose, have been lately raised on the ground formerly belonging to St Gregory's Priory. On the eastern branch of the river Stour, is a lofty and spacious flour mill, called Abbott's Mill, erected from the design of the celebrated engineer Mr Smeaton. It is capable of grinding and dressing into flour 500 quarters of corn weekly. Besides these buildings, there are numerous hospitals and other charitable establishments; two libraries, a free grammar school, &c. An agricultural society was established here in the year 1793, under the name of the "Kent Society for the Encouragement of Agriculture and Industry." and upwards of 700*l.* have already been distributed as premiums for promoting the objects of the institution.

The manufacture of silk goods was first established in Canterbury by the French refugees, who settled in this town after the revocation of the edict of Nantes, and the labouring classes found full employment in the fabrication of lustrings, brocades, satins, &c. From the rapid extension of the cotton trade, however, and other causes, the silk trade gradually declined; and, in the year 1789, Mr John Callaway introduced the manufacture of cottons, and discovered the method of fabricating the piece goods called Canterbury and Chamberry muslins, damasks, &c. in which silk and cotton twist are united in the same fabric. Though this manufacture is carried on in other parts of England, it still flourishes in Canterbury. According to Hasted, about 1000 individuals are employed in the different branches of the silk, cotton, and wool trades. Many of the inhabitants of Canterbury derive their support from the hop plantations round the town, which cover about 2000 acres of ground.

Number of houses in 1800, 1741. Population 9000, of whom 5195 were females, and 3805 males; and those employed in trade and manufactures amounted to 1325. Population in 1811, 10,200. For a full account of this interesting town, see Somner's *Antiquities of Canterbury*, 1640; Gosling's *Walk in and about the City of Canterbury*, 1774; Burnby's *Historical Description of the Metropolitical Church of Christ, Canterbury*, 1783; Hasted's *History and Topographical Survey of the County of Kent*, 12 vols. 8vo, 1797—1801; *The Canterbury Guide*, 1805; but particularly Brayley and Britton's *Beauties of England and Wales*, vol. viii. p. 753, where a full account of the ancient and modern history of this town will be found. (*π*)

CANTHARIDES, in the Materia Medica, is the name given to the *Meloe vesicatorius*, commonly called the Spanish fly, which is found in Spain, Italy, and the South of France. A new substance, called the blistering principle, has been recently discovered in cantharides, by M. Robiquet. See ENTOMOLOGY, MATERIA MEDICA, &c. (*w*)

CANTON, or QUANG-TCHE-FOO, a large and maritime city of China, and capital of the province of Quang-tong, lies on the north-eastern bank of the river Pe-kiang, or Bocca-Tigris, as it is called by Europeans, from a supposed resemblance of this animal seen upon approaching the entrance of one of the branches of it at the first fort. It is fortified by a strong rampart, about six or seven miles in circumference, and consists of three divisions, separated from each other by lofty walls, which, together with the rampart, are built of hewn sand-stones, and covered with all sorts of little trees and plants. Not above one-third of the ground within the walls, however, is filled with buildings, the rest being chiefly appropriated to pleasure-grounds and fish-ponds; and the back part of the city is almost entirely occupied by two hills of considerable height, which are beautifully wooded, and cultivated with great care. But as no European is allowed to enter within the gates, we have no particular account of its interior; and all the accounts of the city of Canton are confined principally to its suburbs, which are indeed much more extensive and populous than the fortified part. The streets are in general long, but narrow and irregular, paved with small round stones, and flagged close to the houses. They are ornamented at intervals with triumphal arches; are kept exceedingly clean, and some of them have a kind of awning extended from house to house, which prevents the sun's rays from incommoding the inhabitants. Each side is entirely occupied by shops, (the dwelling-houses being in general within the walls.) where every variety of manufacture is exposed to sale. These shops sometimes consist of several apartments, of which the one next the street is generally quite open in front, and filled with coarse porcelain and toys; in the one behind, a finer sort of porcelain is sold; the third contains silks, velvets, and other kinds of cloth; and some have a fourth, where tea or other commodities of that description are kept. On great festivals, these long narrow vaults are thrown open, when they are illuminated and ornamented with flowers and trees. Most of the merchants, however, are content with two apartments, the outer one for containing porcelain, and the other for articles of every description.

Some of the streets are appropriated entirely to particular trades, especially cabinet-makers and painters; but in others, apothecaries, shoemakers, goldsmiths, tailors, bookbinders, &c. are all mingled together. In a very long street, nothing but eggs are sold, and the accumulation of millions of them in every shop have a very singular appearance. Several canals run up from the river to the interior of the city, on which boats with merchandise are continually passing and repassing; and when any of them cross a street, it is covered in by an arch, which is ascended on each side by a flight of twelve or fourteen steps. All burdens are carried here by porters, who in general go barefoot and bare headed. A horse is almost never seen in this town, and the only vehicle for both sexes are palanquins, which are only chairs similar to ours, but more elegantly decorated, and carried by poles supported on men's shoulders. The streets are daily crowded with an immense concourse of people, which renders it difficult for a stranger to make his way through them; and his ears are continually stunned with the cries of the porters, who, passing along at a round pace, keep bawling out *Li li*, "clear the way." The houses are in general built of brick, and seldom exceed two stories, except those of some of the most wealthy merchants and mandarins, which are spacious and lofty, and are sometimes elegantly fitted up in the English style, and surrounded with an extensive garden, adorned with ponds and parterres. The principal public buildings at Canton are *joss-houses*, or temples, which are scattered over all the city and suburbs. These contain the images of Chinese worship, before which are placed, at particular seasons, a great variety of sweet-meats, dressed food, and incense, which is kept perpetually burning. The palace of the Tsong-too, or viceroy, is rather a handsome building, but quite in the Chinese taste, and disfigured with the images of monstrous animals.* In the environs of the town there is a regular theatre, in a large square or market-place. The most beautiful part of Canton, however, is the quay which contains the European factories. They extend a considerable way along the banks of the river, and consist of a range of elegant buildings, with yards and warehouses, each having the flag of the nation to which it belongs hoisted before the gate from sun-rise to sun-set. Of these, the most splendid and extensive is the British factory, which has in front an elegant virandah, supported by handsome pillars, and paved with square marble slabs. This virandah, reaches to the water's edge, and commands an extensive view of the river in both directions, and of a beautiful country on the opposite bank. These buildings are occupied by the supercargoes of their respective companies, who transact all the business with the Chinese merchants, disposing of the cargoes brought to market, and supplying the ships with others for Europe in return. About a league above Canton is the *Boat-town*, which consists of about 40,000 barks of various sizes, arrayed in straight rows, and forming a floating city, with regular streets. Each bark is covered and lodges a whole family, with their grandchildren, who have also a small boat, in which they fish, or go on shore to follow their respective employments. The number of persons who are expressly prohibited by the law from settling on shore, and are thus obliged to live upon the water, may amount to nearly 300,000, including the women of the town, who are estimated at 40,000. They are chiefly composed of the poorer sort of Chinese, or rather the descendants of the Tartars.

As Canton is the only emporium of European commerce in the empire, a full account of its trade will be given under the article China. Its principal article of exportation is tea, of which about 13,000,000 of pounds is said to be consumed by Britain and her dependencies, and 5,000,000 by the rest of Europe.

In 1795, while the English private trade in this commodity amounted to 23,733,810 lbs., the other nations of Europe and America received only 5,577,200 lbs. of which 4,096,800 lbs. were exported in Dutch vessels. Its other exports consist chiefly in porcelain, raw and wrought silks, nankeen cloths, camphor, alum, quicksilver, turmeric, &c.; and its imports from England are woollens, lead, tin, furs, &c. supposed to exceed a million sterling. All European vessels stop at Wampoa, an anchorage opposite Danes island, about 12 miles from Canton, and here deliver and load their cargoes, which are transported to and from the factories in junks. None are on any account permitted to go beyond it; indeed ships of great draught could not proceed much farther, by reason of the shallowness of the water.

The country around Canton is pleasant and healthy, abounding in all the necessaries and delicacies of life; and the approach to the city by water, presents the most beautiful and picturesque scenery that can be imagined. "In the back ground," says a late voyager, "high and fantastically shaped mountains raise their summits among the clouds, while all around, with very little exception, to the feet of these mountains, the ground seems a level verdant plain, intersected with innumerable branches of the river, and artificial canals. It is this last circumstance that renders the scenery so truly picturesque; for a person can only see that particular branch on which he is sailing, while he beholds with amazement a variety of ships, junks, and vessels of every description, gliding as if by the effect of magic, through fields and villages, winding among castles, pagodas, and monasteries, sometimes on one side of them, sometimes on the other: sailing in an infinite variety of directions, and forming the most whimsical, novel, and entertaining prospect I ever remember to have seen." The garrison of Canton consists of about 20,000 Tartars, and its population is estimated at a million and a half. According to Mr Raper, the standard temperature of this city in 1774 was 75° 4′; the greatest heat in January being 66° 5′, and the least 51°; the greatest heat in August 89°, and the least 80°. In the winter season there is sometimes a difference in the temperature of 20° or 25° between morning and noon. N. Lat. 23° 7′ 50″, E. Long. 113° 2′ 15″. See An Account of the Trade, and Tables of Exports and Imports, in *Oriental Repertory*, vol. i. p. 280, and vol. ii. p. 301; Osbeck's *Voyage to China and the East Indies*, vol. i. p. 214; *A Voyage to India, China, &c.* p. 66, in Phillip's *Collection*, vol. v.; Barrow's *Travels in China*; and Staunton's *Embassy to China*, vol. ii. (L)

CANTON, John, an ingenious experimental philosopher, was the son of a broad cloth weaver, and was born at Stroud, in Gloucester, on the 31st of July 1718, O. S. He made an early proficiency in mathematics, under the care of Mr Davis, the school-master of his native place; and before he had reached his tenth year, he had been instructed in vulgar and decimal arithmetic. His attention was next turned to the higher subjects of algebra and astronomy; but while his mind was fully bent on these interesting pursuits, his father took him from school to educate him for his own profession. All his leisure time, however, was still devoted to the acquisition of science; and with the insufficient means which he was able to command, he made a rapid progress in his favourite studies. By the help of the Caroline tables, young Canton computed lunar eclipses and other celestial phenomena; and such was his ardour for science, that when the rest of the family were asleep, and with the assistance of a candle which he had secreted, he constructed, with a common knife, an upright sun-dial, which shewed the time of the day, the rising of the sun, and his place in the ecliptic. The display of this dial on the front of his father's house, introduced Canton to the notice of some of the neighbouring gentlemen, who offered him the full use of their libraries. A pair of globes, and Martin's Philosophical Grammar, which he obtained from these libraries, contributed greatly to extend his knowledge of astronomy and natural philosophy.

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* Under the article Civil Architecture, we shall give a view of this building, and also of part of the celebrated temple of Fo, as specimens of Chinese architecture, from original drawings in the possession of Patrick Begbie, Esq. of Castlehill, who has kindly favoured the Editor with some new facts respecting Canton, and with the use of several beautiful and valuable plans and drawings of that city, which were executed by a Chinese.

About this time, he was introduced to the Reverend Dr Henry Miles, a dissenting minister at Tooting, and a Fellow of the Royal Society, who, perceiving the abilities of Canton, obtained permission from his father to take him to the metropolis. Mr Canton, accompanied with his patron, arrived in London on the 4th of March 1737, and, after spending some time at Tooting under the roof of his friend, he articled himself for five years as clerk and assistant to Mr Samuel Watkins, who superintended an academy in Spital-square. In this new situation, the abilities and exemplary conduct of Mr Canton gave such high satisfaction, that, on the expiration of his clerkship, in May 1742, he was taken into partnership for three years; and on the death of Mr Watkins, he succeeded to the academy, which he superintended with great honour and usefulness during the rest of his life.

The attention of Mr Canton was at this time particularly directed to the subject of electricity, which was now beginning to assume the form and dignity of a science. In the year 1747, Mr William Watson laid before the Royal Society a method, discovered by Mr Canton, of determining the quantity of electricity accumulated in the Leyden phial. When the phial (Muschenbroek's phial of water) was filled with electricity, he hung a slender piece of wire to the suspended gun-barrel, which was for this purpose detached from the globes. On applying the wire of the electrified phial to the wire hanging at the gun-barrel, a small snap is perceived. This is discharged by touching the gun-barrel with the finger, which likewise snaps; and thus alternately electrifying and discharging, he proceeded till the whole electricity of the water was dissipated, which sometimes required 100 discharges. The acquired electricity of the water was estimated by the number of shocks. Unless the electricity was discharged every time, the snaps from the wire of the electrified phial to the gun-barrel was scarcely perceptible. About the end of the year 1749, Mr Canton assisted his friend Benjamin Robins, Esq. in his experiments for ascertaining the height to which rockets ascended, and the distance at which their light is visible; and in January 1750, was read at the Royal Society his "Method of making artificial magnets without the use of, and yet far superior to, natural ones.") The method described in this curious paper had been for some time known to its author, but from some motives of delicacy to Dr Gowin Knight, who had kept secret his method of making artificial magnets, Mr Canton delayed the communication till he was urged to publish it by the president of the Royal Society. In 1750, Mr Canton was admitted a fellow of the Royal Society, and was honoured with the gold medal, for his valuable paper on artificial magnets. In 1751, he received the honorary degree of M. A. from one of the colleges in Aberdeen, and was chosen one of the council of the Royal Society.

In the year 1752, Mr Canton repeated with success Dr Franklin's celebrated experiments of drawing lightning from thunder clouds, by means of a kite; and having for a considerable period continued his experiments upon the electricity of the clouds, he found them sometimes negative, and sometimes positive; and he imagined, that rarefied air communicated electricity to the clouds, while their electricity was abstracted from them by condensed air. In 1753, he laid before the Royal Society, a paper entitled "Electrical Experiments, with an attempt to account for their several phenomena," which was followed, in 1754, with another paper on a similar subject. These valuable communications contain many interesting facts and discoveries, which we shall have occasion to notice in a future part of our work. The explanation of the phenomena of shooting stars having been proposed as the prize question, in the Lady's Diary for 1752, Mr Canton transmitted an anonymous paper on the subject, which was immediately recognised by his friend Mr Thomas Simson, who then conducted the Diary. In transmitting the prize, Mr Simson remarks, that though Mr Canton had concealed his name, yet he knew him to be the author, as no other person was capable of giving such a solution.

In the Gentleman's Magazine for September 1759, Mr Canton published a letter on the electrical properties of the Tourmalin; and, in the same year, the Royal Society received his "attempt to account for the regular diurnal variation of the horizontal magnetic needle, and also for its irregular variation at the time of an aurora borealis." In 1761, he communicated to the Royal Society, his observations on the transit of Venus. In 1762, was read his letter addressed to Dr Franklin, containing remarks on Mr Delaval's electrical experiments; and, in the same year, he communicated his "experiments, to prove that water is not incompressible." In these experiments, which were equally simple and conclusive, he put the fluids to be examined into a glass ball, with a slender tube attached to it. When the glass ball was placed *in vacuo*, he observed how much the fluids increased in bulk, from the removal of atmospherical pressure; and hence he was able to estimate their various degrees of compressibility.

As the result of these experiments was contrary to that of the famous Florentine experiment, they were repeated before a committee of the Royal Society, who found them perfectly accurate; and in consequence of their favourable report, the gold medal was unanimously voted to Mr Canton, and delivered to him on the 30th November 1765. In the year 1768, he communicated to the Society, "an easy method of making a phosphorus, that will imbibe and emit light like the Bolognian stone, with experiments and observations." In 1769, he was one of the committee appointed to consider of the best method of fixing conductors on St Paul's; and, in the end of the same year, appeared his "experiments to prove that the luminousness of the sea arises from the putrefaction of its animal substances."

In consequence, probably, of his studious and sedentary habits, Mr Canton was seized with a dropsy in the thorax, of which he died on the 22d of March 1772. He left behind him several children; and he was succeeded in the academy by his eldest son. (π)

CANTUA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 134.

CANUTE, king of Denmark, surnamed the *Great*, was, upon the death of Edmund, proclaimed king of England, A. D. 1017, after his countrymen had contended for possession of the country above two hundred years. As a pretext for the exclusion of Edmund's family, it was affirmed, but without truth, that the succession of Canute to the whole kingdom of England, on the death of Edmund, had been stipulated in a late convention between the two princes. In the beginning of his reign, Canute struck terror into his new subjects, by the many sacrifices he made to his crown, and by the vigour of his administration. Under various pretences, he banished some of his nobles, put others to death, and sent the two young sons of Edmund out of the kingdom; but when he found himself securely seated on the throne, he relaxed the reins of government; and made himself popular by extinguishing national animosities, and by effecting a complete reconciliation betwixt his Danish and his English subjects.

To secure the affections of the English, and prevent any attempts for restoring the princes of the antient royal family, he married Emma, the widow of the late king Ethelred, who resided with her two sons, Alfred and Edward, at the court of her brother Richard, duke of Normandy. By that marriage, and by giving his own sister in marriage to Richard, he artfully disarmed the resentment of that powerful rival, who had declared himself the protector of the young princes, and had threatened to attempt their restoration to the throne of their ancestors.

Finding the kingdom now in complete tranquillity, and having no reason to dread the revolt of the English, Canute undertook a voyage to his native kingdom of of Denmark, which was then at war with Sweden. He carried with him a body of English troops, commanded by Earl Godwin, who gained a complete victory over the enemy, without the least assistance from the Danes. This brave action endeared the English to their new sovereign. Godwin was created Earl of Kent, and was honoured with the most distinguishing marks of royal favour. Upon his return to England, Canute directed his attention to the establishment of good laws, the building of churches and monasteries, and other pious and useful works.

In the year 1025 he undertook a second voyage to Denmark, which was again invaded by the Swedes, in which he was not successful; but, two years afterwards, he made ample reparation for his losses. Having revived an old pretension to the throne of Norway, then filled by Olaus, a weak prince, he made an unexpected descent upon that country with a large body of English troops, dethroned the reigning monarch, and took possession of the kingdom. This conquest of Norway fully satisfied his ambition. From that time he laid aside all his warlike schemes, and employed himself in building churches, endowing monasteries, importing reliques, and in various acts of devotion; and might have had a much better claim to saintship than many who fill the Roman calendar. In the same spirit of devotion, he undertook a journey to Rome, and obtained for his subjects the important privilege of exemption from toll-duty, when travelling through Germany, France, and Italy, by which the pilgrims and other travellers were relieved from a great expence, and freed from many insults and oppressions to which they had formerly been subject. A letter written by himself, giving an account of that exemption, is still extant at Malmsbury. In his way home, he purchased at Pavia the arm of St Augustine, for one hundred talents of silver, and one talent of gold; a much greater sum than the finest statue of antiquity would have cost in those days. He died at Shaftesbury, A. D. 1036, in the 19th year of his reign; and was buried in the old monastery in Winchester.

Historians have surnamed this prince the *Great*, a title but too frequently bestowed on conquerors; as if true greatness consisted in invading the rights and properties of their fellow-creatures, and in overrunning foreign countries with their victorious arms. Canute's claim to that title might be better founded upon the wise and peaceful administration which distinguished the latter part of his reign. He who at first made no scruple to wade through the blood of the innocent, and set at defiance the sacred laws of religion and justice, when they opposed his ambitious schemes, was, in the latter part of his reign, not less remarkable for his sacred regard to religion, and for the exercise of every moral virtue; insomuch, that he gained the entire affection of his own subjects, and the universal esteem of foreigners. We need not be surprised, however, that a prince whose reign had been so prosperous, the sovereign of Denmark, Norway, and England, was surrounded with flatterers. Some of them, it is said, carried their adulation so far, as to declare that nothing in nature dared to disobey his commands. Offended at their extravagant praises, and desirous to make them sensible of their folly and impiety, he commanded that a chair should be placed upon the beach at Southampton, while the tide was advancing; and, seating himself in it, he thus addressed the approaching billows. "O sea, thou art my dominion, and the land on which I sit is mine: I charge thee not to approach farther, nor dare to wet the feet of thy sovereign." Regardless of his command, the waves advanced, and forced him to retire. Turning to his courtiers, he addressed them in language which might not be unworthy of the ears of sovereigns to hear; "Learn from this example the insignificance of all human power, and that the word of God alone is omnipotent." Rapin's *Hist. of England*, vol. ii.; Hume's *Hist. of England*, vol. i.; Henry's *Hist. of Great Britain*, vol. iii. (A. F.)

CAOUTCHOUC, a soft, dense, elastic, vegetable substance, well known under the name of *elastic gum*, and *Indian rubber*. It is remarkable not only for the above characters, but also for its wonderful inflammability; and for some very singular chemical and mechanical properties. In this country it is commonly to be purchased in the form of birds and bottles of a spherical shape.

This substance appears to have been introduced into Europe about the beginning of the eighteenth century; but nothing was known of the mode of its production, until the year 1736, when M. De la Condamine presented a paper to the French academy, describing the tree from which it is obtained, and the mode of preparation. From De la Condamine's statement, it appeared, that it was obtained from a tree that grows in the province of Esmiraldas, in the Brazils, and which is called by the natives Hhevé. This tree, on being wounded, yields a milky juice, which becomes inspissated on exposure to the air, and forms caoutchouc. The same tree was afterwards found on the banks of the Maragnon, by Don Pedro Maldonado; and in Cayenne, by M. Fresnau. The death of the former of these gentlemen prevented the publication of his observations respecting it. The latter read an account of it in the French academy in 1751. More recent observations have now determined, that caoutchouc is obtained from two South American plants, the *Hævia caoutchouc*, and the *Jatropha elastica*. In South America, the juice, which is obtained by incision, is spread over clay, moulded into the desired form, in successive layers, until the vessel be sufficiently thick. The whole is then suspended over the smoke of burning vegetable matters, which hardens and colours it. Previous to this last mentioned process, the exterior of the vessel is ornamented by various means. When the whole preparation is completed, the clay mould is broken into pieces, and taken out. The vessel is then fit for use.

Besides the two South American plants already mentioned, there are several others that yield caoutchouc. The principal of these are, the *Ficus Indica*, the *Artocarpus integrifolia*, and the *Urceola elastica*. The properties of the caoutchouc, obtained from the *urceola*, have been accurately examined by Mr Howison, surgeon at Prince of Wales' Island; and he has determined the following facts: The thickest and oldest stems of the urceola yield the largest proportion of caoutchouc. On cutting these, a milky, pungent juice exudes. On exposure to the air, a decomposition takes place, and a firm coagulum, which is the caoutchouc, separates from the thin portion. This same effect is produced by time, when the air is carefully excluded. If oxymuriatic acid be poured into the milky juice when first exuded, the caoutchouc is precipitated, and the acid loses its peculiar odour. Fourcroy supposed, that this change was induced by the absorption of oxygen. Should Mr Davy's opinions be conclusive, some other source of the phenomenon must be sought for.

The chemical properties of caoutchouc have attracted the attention of philosophers since the time of Mr Macquer, who published, in the Memoirs of the French Academy in 1768, an account of his experiments on it. Although this celebrated chemist determined many facts previously unknown, yet he adopted some erroneous opinions, the fallacy of which was pointed out by Mr Berniard, whose paper contains the greater proportion of all the facts now known respecting this interesting substance. Fourcroy and Grossart have also contributed to our knowledge of this subject.

Pure caoutchouc, when recent, is of a yellowish white colour, which changes to a smoke grey on exposure to the air. Most commonly it is black, or blackish brown, particularly that, which comes from South America: this circumstance is owing to the smoking during the formation of the vessels. Caoutchouc is tasteless and inodorous, except when heated; it then yields a faint peculiar smell. It is soft, pliable, adhesive, wonderfully elastic and tough. Its specific gravity is 0.9335.

Mr Gough took thin slips of caoutchouc, previously rendered pliable by being immersed in water, observed the temperature, by applying these slips slightly extended to the lips, and suddenly stretched them, when a very sensible increase of temperature took place. When allowed to relax to the original degree of extension, the temperature was suddenly returned. The same gentleman also ascertained, that if these slips be plunged into cold water at the time that they are considerably extended, that they lose their contractile power, and retain nearly the same degree of extension; but if plunged into warm water, or if kept warm for some time in the hand, they become again elastic. The specific gravity of caoutchouc is considerably increased, by being weighed when in a state of tension under water. These facts are valuable, not only as they give new characters of this substance, but as they are beautiful illustrations of the theory of latent heat. See CHEMISTRY.

Caoutchouc is variously acted upon by different agents. When exposed to a high temperature, it is softened, becomes viscid, swells, emits a peculiar odour, and burns with a very bright flame. If a more moderate heat be applied, it retains its viscidity, never resuming its elastic state.

The atmosphere affects the colour; but we are not aware of any alteration which it produces on the other properties of caoutchouc.

Water was supposed, by Grossart, to be a solvent of this substance, merely because it is softened, and becomes somewhat transparent on the edges, on being immersed for some time in boiling water. It is very clear, however, that this effect depends on the increased temperature, rather than on the water itself. When boiled for a very considerable time, no alteration takes place, except in a way that is decidedly referable to the agency of heat. By this heating, the caoutchouc is rendered so adhesive, as to admit of being united very closely by simple pressure.

It was very soon determined, that alcohol does not dissolve it. It, however, renders it colourless. M. Macquer confirmed these observations.

The same chemist also found, that sulphuric ether was a solvent of caoutchouc; but Berniard afterwards repeated the experiment without success. He also tried the nitric ether, and found it to be a very imperfect solvent. Mr Cavallo was the first that determined the causes of this discordance, between two chemists remarkable for their accuracy. This philosopher found, that ether is a solvent, only after having been well washed with water. Subsequent experience has shewn this statement to be correct. It is evident, that Macquer and Berniard had used the same kind of ether in two different states. On evaporating the ether, the caoutchouc remains unaltered; hence, from the solution, various instruments may be made with facility. Pelletier found, that the solution is considerably facilitated, by boiling the caoutchouc for some time before it is put into the ether. Dr Roxburgh did not find that the nitric acid dissolved the caoutchouc, which he obtained from the *Urceola elastica*.

The volatile oils dissolve caoutchouc; but on evaporation, it remains clammy and unfit for any use. The fixed oils have a partial effect when aided by heat; and melted wax dissolves a very minute portion.

Dr Thomson discovered, that ammoniacal gas dissolves a very minute proportion of caoutchouc, although Berniard had denied the action of the alkalies. The Doctor has further determined, that all the alkalies produce similar effects.

The acids decompose caoutchouc very partially.—Mr Hatchett obtained about 12 per cent. of charcoal from caoutchouc that had been charred by sulphuric acid. When acted upon by nitric acid, azote, carbonic acid gas, prussic acid gas, and oxalic acid, are said to have been formed.

Petroleum dissolves it, and it remains unaltered after evaporation.

When distilled, it gives out ammonia, a watery liquid, empyreumatic oil, and charcoal.

Such are the leading properties that have been ascertained of this singular substance. It exists in many plants, in which it has usually been confounded with other matters. In the fluid state in which it is found in plants, it unites readily with water, by which means it may be easily separated from the stalks. This fact is a valuable one, as it may hereafter be employed in the manufacture of instruments made of caoutchouc. When combined with resin, it may be separated by alcohol; and, for its separation from gum, or extractive, the following formula is given by Hermbstadt: "Digest a part of the plant containing it (caoutchouc), first in water, and then in alcohol, till all the substances soluble in these liquids are extracted. Dry the residuum, and digest it in four times its weight of rectified petroleum. Express the liquid part, by squeezing the substance in a linen cloth. Let this liquid remain several days to settle, then decant off the clear liquid part, mix it with a third part of water, and distil; the caoutchouc remains behind.

Opium is said to contain caoutchouc, and the insoluble part of mastic possesses some of its properties.

Caoutchouc is used for various purposes. In South America, whence it was first brought to Europe, it is formed into solid masses, with which the natives play at a game somewhat resembling that of fives. It is used for bottles and boots, for which it answers extremely well. It is also formed into torches, which burn with great splendour.

In Europe, it is commonly used to take out the marks of blacklead pencils; for syringes, bougies, catheters, elastic tubes, and varnish.

Many methods have been employed to fashion it into the forms necessary for the above instruments. The expense of ether, and the rapidity with which it evaporates, precludes its use as a solvent; and the peculiar effect of the oils, already noticed, unfits the caoutchouc, after solution, for any purpose. The best mode of forming tubes and bougies appears to be, to cut a bottle of caoutchouc into a thin narrow slip, which must be heated in boiling water, until the edges become transparent; then to wind the caoutchouc slip, accurately applying the edges to each other around a piece of cane, previously split into two, and having a slip of whalebone interposed between them. When the whole has been accurately applied to the surface of the cane, it may be plunged into boiling water again, and any inequalities on the surface removed. A slight varnish of the caoutchouc applied to the whole surface, may render the surface still smoother and more perfect. The slip of whalebone being withdrawn, the cane may be readily taken out, and the tube will be fit for use. Or should the surface be enequal, it has been proposed to immerse the tube or bougie into a glass tube filled with the ethereal solution; the diameter must scarcely exceed that of the bougie: the whole apparatus is then to be plunged into hot water, the ether will be evaporated, and a smooth coating given to the instrument. This will be too expensive for common use.

Cloth impregnated with the recent juice of the urceola is perfectly impervious to water, and may be applied to a multitude of economical purposes. The chief objection is the scarcity of the substance, which enhances its value. It forms the best varnish for balloons, and indeed for all those instruments that ought to be impervious to water and air. See Thomson's *Chemistry;* Murray's *Chemistry; Annales de Chimie*, vol. xi. xii. and xxiv.; *Philosophical Magazine*, vol. xxii.; Aikin's *Dictionary of Chemistry and Mineralogy; Medical and Physical Journal*, vol. iii.; Manchester's *Memoirs*, vol. ii. 2d series; *Asiatic Researches*, vol. v. (C. M.)

CAPE OF GOOD HOPE.

Cape of Good Hope, an extensive European settlement on the southern extremity of the African continent, lies between 29° 55′, and 34° 47′ S. Lat., and between 17° 36′, and 28° 17′ E. Long. It is bounded on the west and south by the ocean, on the east by the Great Fish River, and Caffreland; and on the north by the river Koussie, and the country of the Bosjesmans. Its mean length is nearly 550, and mean breadth 233 English miles, and it comprehends an area of about 128,150 square miles. These boundaries are, in a great measure, imaginary; and to the northward especially, might be extended very far beyond what is now accounted the limit, without encroaching upon the territory of any nation; while on the eastern side of the province, the Caffres have for many years been systematically pressing in upon the line of demarcation stipulated between them and the Dutch; and they actually held possession of a large tract of the most productive part of the province, to the westward of the Great Fish River, until a very few months ago, when they became more bold in their aggressions, and murdered the land-droost, or chief magistrate of Graaf Reynet, the district contiguous to their country, with all his family, with the design of driving in the colonists, and adding to their encroachments. Colonel Graham was sent by the governor with an adequate force, and vigorously pushed into the part of the country they inhabited, routed them, and drove them within their limits. The Caffres have been classed amongst savages; but their steady perseverance in pursuing a uniform design for so long a period, would do credit to the policy of an European state. Their system of espionage is no less complete than their success in concealing their own circumstances from their neighbours: the British troops were, on the late occasion, astonished to find a very considerable extent of land in a state of high cultivation, at a very small distance from the residence of the magistrate.

We are not to estimate, however, the value of this settlement by its extent of surface. The greater part of it is covered with naked mountains, or sterile and unprofitable plains, many of which are totally incapable of any kind of culture, and even without a plant or shrub fitted for the support of animal life; while others are, in the season, covered with verdure, and frequented by antelopes. These mountains generally run in the direction of east and west, except those in the Cape peninsula and the chain, which, beginning at False Bay, stretches along the western coast to the northward, as far as the mouth of Elephant's river, and is about 210 miles in length. The most southern range extends along the coast, at between 20 and 60 miles distance from the sea; the central range, called Zwarteberg, or Black Mountain, runs parallel to it, is more lofty and rugged, and in many places is composed of double and sometimes treble chains; and the northern range, or Nieuwveld mountains, which are still higher, (supposed to be about 10,000 feet above the level of the sea,) have their summits sometimes covered with snow during the severity of the winter season. The chain which extends from the extremity of the Cape peninsula northwards, is terminated by the Table Mountain, and its two wings, the Devil's Hill, and Lion's Head. These three may be almost considered as one mountain, for though their summits are disunited, yet they are all joined at a considerable elevation above the common base. The north side of the Table Mountain, which faces the town, presents a bold and almost perpendicular front, extending nearly two miles in length, and broken into three divisions by two immense chasms, which give it the appearance of a mighty ruin. Its height is 3582 feet above the level of Table Bay, that of Devil's Hill is 3315, and the Lion's Head is 2160. The mountains of this country, according to Mr Barrow, "at a distance, possess neither the sublime nor the beautiful; but the approach to their bases, and the kloofs, (or passages by which the mountains are ascended,) are awfully grand and terrific; sometimes their naked points of solid rock rise almost perpendicularly, like a wall of masonry, to the height of three, four, and even five thousand feet, resembling the Table Mountain; sometimes the inclination of the strata is so great, that the whole mass of mountain appears to have its centre of gravity falling without the base, and as if it momentarily threatened to strew the plain with its venerable ruins; in other places, where the looser fragments have given way, they are irregularly peaked, and broken into a variety of fantastic shapes." We are also informed, by the same traveller, that the component parts of those mountains consist of sandstone, resting upon a base of granite. This base, however, is in some mountains considerably elevated above the general surface of the country, and, in others, its summit is sunk far beneath it.[*] In the Table Mountain, the granite base terminates only at about 500 feet above the level of the sea. From that commences a horizontal stratum of siliceous sandstone, of a dirty yellow colour, which is covered by a deep brown sandstone, containing calciform ores of iron, and veins of hematite, and is surmounted by a mass of a whitish grey shining granular quartz, about 1000 feet in height. The rocks on the summit, which have entirely passed into sandstone, are surrounded with myriads of oval shaped and rounded pebbles of semitransparent quartz, which were formerly imbedded in them; but no shells, petrefactions of fishes, or impressions of plants, are to be found, as some travellers have asserted. The composition of the other mountains is nearly similar to that of the Table Mountain; and the stratification of the whole colony is also much the same as that of the Cape peninsula. Blue compact schistus, generally placed in parallel ridges, in the direction of north-west and south-east, but frequently interrupted by large masses of a hard flinty rock, of the same colour, belonging to that class of aggregated stones, called, by Mr Kirwan, *granitelles*, forms the substratum. This is covered with a body of strong clay, which is coloured with iron, and abounds with brown foliated mica; and in which are imbedded immense blocks of granite, so loosely cemented together that the constituent parts can easily be separated by the hand. The mica, the sand, and indeed the whole bed of clay, is supposed, by Mr Barrow, to have been formed by the decomposition of the granite. Large masses of these aggregated stones are found lying entirely exposed between the Lion's head and the sea. They are mostly rent, and are falling asunder from their own weight, and some of them are so completely excavated that nothing but the crust or shell remains. Such hollow blocks are very common on the hills of Africa, and are frequently converted into habitations by runaway slaves. "There is neither a volcano, nor a volcanic product," says Mr Barrow, "in the southern extremity of Africa, at least in any of those parts where I have been, nor any substances that seem to have undergone the action of fire, except masses of iron-stone, found generally among the boggy earth, in the neighbourhood of some of the hot springs, and which appear like the scoriæ of furnaces. Pieces of pumice-stone have been picked up on the shore of Robben-island, (or Seal Island, in the mouth of Table Bay,) and on the coast near Algoa bay, which must have been wafted thither by the waves, as the whole basis of this island is a hard and compact blue schistus, with veins of quartz running through it; and, of the eastern coast, iron stone and granite."

The rivers, which intersect this extensive colony, are of very little advantage to it, either for the purposes of agriculture or navigation. Many of them are merely periodical torrents, which continue to flow during the rainy season, but which, during the summer, leave their deep sunk beds almost completely dry; and the rivulets, which are supplied by the mountain springs, have scarcely escaped from the lofty sources, before they are either absorbed or evaporated. The permanent rivers, some of which contain sufficient water for the navigation of small craft, for several miles up the country, are all, except the Knysna, rendered inaccessible, by a bed of sand, or a reef of rocks across the mouth: The principal of these, on the west coast, are, *Oliphant*, or Elephant's river, which runs in a northerly direction along the foot of the western chain of mountains, and falls into the Atlantic in S. Lat. 31° 30′; and the *Berg*, or Mountain river, which has its source in the mountains which inclose the vale of Drakenstein, and discharges itself into St Helena bay. Those on the south coast are, *Broad* river, which falls into St Sebastian's bay, and at its mouth is nearly a mile broad. *Gauritz* river collects its waters from the Black Mountains and Karroo plains, and during the rains is the most rapid and dangerous in the colony; *Camtoos* river, which is supplied from the same part of the country, but more easterly, empties itself into a bay of the same name, and, within the bar, is deep enough to float a ship of the line; *Sunday* river, which rises in the Snewberg, or Snow mountains, and falls into Zwart Kop's bay; and Great Fish River, called *Rio Infanté* by the Portuguese, which taking its rise far towards the north, about 200 miles from its mouth, collects in its long course a multitude of tributary streams, and forms the eastern boundary of the colony. Besides these are *Zwart Kop's* river, *Keurboom* river, and Knysna; and numerous streamlets on the southern coast, which continue their feeble course throughout the whole year, but whose channels are so deep, that little benefit can be derived from their waters to the lands in the vicinity. All these rivers are well stored with perch, eels, and small turtle; and the neighbouring shores abound with every kind of fish peculiar to these seas. The principal bays on this coast, besides those which have been already mentioned, are Plettenberg's bay, Mossel bay, False bay, Simon's bay, Haute or Wood bay, Table bay, and Saldanha bay. Of these, Saldanha bay is the most commodious, and affords at all seasons very excellent shelter and anchorage. It is about 15 miles long, in the direction of north and south, and its entrance, which is through a ridge of granite hills, is only between two and three miles broad: the scarcity of wood and water, however, in its neighbourhood, must always prevent it from becoming a place of general rendezvous for a fleet.

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[*] It has been observed, that wherever the granite rises above the general level of the country, numerous springs issue from the surface of the rock; and that the contrary position is invariably attended with a scarcity of water. This last, indeed, is the more general situation of the granite throughout the colony.

The soil of this country is in general of a stiff clay, or light sand, which requires nothing but water to make it most fertile in every vegetable production. Wherever springs are found, their vicinity is always enriched with the most luxuriant verdure; but these are so very rare, particularly in the northern part of the colony, that they scarcely interrupt the prospect of uniform sterility, and serve only to render more dreary the surrounding wilderness. The immense plains, called *Karroo*, are, for many months, completely devoid of every appearance of vegetation; and the Great Karroo, which extends nearly 300 miles in length, and 80 in breadth, is uninhabited by a human creature, and scarcely ever moistened with a shower. Its unvaried surface of clay, sprinkled over with sand, is only broken by hills still more barren; and, should a blade of grass, or a stinted shrub, meet the eye, during the hot season, its parched appearance betrays the poverty of its parent earth, which can scarcely afford it sufficient nourishment to preserve its existence. Yet it is astonishing to behold the genial influence of the rains in clothing them with rich verdure, and then they are resorted to by the various sorts of antelopes, which again are followed by lions. In these Karroo plains, the botanist will find his choicest harvest of succulent and many other plants. The belt of land, however, which is inclosed by the southern range of mountains and the sea, possesses a deep and fertile soil, which, being refreshed by frequent rains, is clothed with grass, and in many places well wooded with fruit and forest trees; and, from its proximity to the ocean, it enjoys a more mild and equable temperature than the northern plains. The beauty and fertility of the country increase as we advance eastward; and the banks of the Great Fish River are covered with shrubbery of the most beautiful and variegated foliage, and enlivened with numerous birds, and a variety of game, particularly of the antelope kind. There are also some fertile spots on the western coast, particularly between Berg river and Saldanha bay, and in some parts of the Cape peninsula.

The climate of the Cape is considered as very salubrious, and many invalids from India have been restored to health by its salutary influence. The year is here divided by the inhabitants into two periods, the good and the bad monsoon. The first commences in September, and answers to our summer. It is then the south-east winds prevail. They sometimes blow in squalls with great violence, and then every door and window in Cape Town is carefully closed up, to keep out the dust and heat. During the continuance of the storm, the Abbe de la Caille observed, that "the stars look larger, and seem to dance; the moon has an undulating tremor; and the planets have a sort of beards like comets." These winds are of a dry and blasting quality, and destroy the foliage and blossoms of such fruit trees as are not sufficiently sheltered. The inhabitants also suffer from their baneful influence, as they relax and fatigue the powers both of the body and mind, and render them almost entirely incapable of exertion. But they are of great service in keeping up a constant circulation of the air, which in some measure counteracts the reflected heat from the face of the Table Mountain, which would otherwise be insupportable. The mornings, during this season, are in general hot and sultry, but the breeze springs up about mid-day, and, dying away towards the evening, leaves the atmosphere cool and refreshing. The thermometer, in the hottest months, varies from 70° to 90°; but often remains for days at 83° or 84°, and has sometimes risen to 105° in the shade. On the approach of winter, the south-east wind becomes less frequent and violent, and is at length succeeded by the north-west, which is generally attended with thick fogs and heavy rains. Thunder storms are also not unfrequent, and often last for two or three days. The rains descend in torrents, sometimes for many days, without the least interruption, particularly during the months of June and July. Such torrents have fallen after a thunder-storm, that in a few hours the water has been some feet deep in the road leading into Cape Town. It frequently occurs in the eastern part of the province, that what is called a river, is dry for perhaps eleven months in the year, and becomes an impassable torrent in a few hours. The air then feels chilly, raw, and disagreeable; and the common temperature of this season is from 50° at sunrise, to 60° at noon. It, however, sometimes falls so low as 40°; and on the more elevated Karroo plains, it is generally below the freezing point by night, and from 70° to 80° at mid-day. In the division of Roggevelds, the cold is very intense. The mercury in the barometer often rises higher in the clear cold days of winter than in the serene weather of summer; and its range in the former season is from 29.46 to 30.35 inches, while in the latter it is only from 29.74 to 30.10. One considerable inconvenience of this climate, which cannot but prove in some measure prejudicial to the health of the inhabitants, is the sudden change of temperature. It is not unusual for the thermometer to rise 30° in the course of five or six hours; and, indeed, the frequency of consumptive complaints is, by many, ascribed to these vicissitudes.* The most fatal diseases, however, which are common to the natives, arise from a different cause, and may, in general, be attributed to their excess at table, and want of exercise. Many of the inhabitants in the remote parts of the province, habitually use animal food three times a day, seldom accompanying their repasts with any portion of vegetables, and frequently without bread; and when an excess of ardent spirits is combined with such pernicious habits of life, affections of the liver and other diseases are the result. An instance of longevity is rarely to be met with, and few even exceed the age of sixty. The annual mortality at Cape Town, taken on an average of eight years, ending 1797, was about two and a half in the hundred among the white inhabitants, and under three in a hundred among the slaves. This latter class, however, who live in the country, from their coarse food and hard labour, and from their being exposed in all seasons, in the fields, to the severity of the climate, are very subject to bilious fevers, which annually carry off considerable numbers.

The colony is divided into five districts, or Droosdys, viz. the CAPE, STELLENBOSCH, DRAKENSTEIN, ZWELLENDAM, and GRAAF REYNET. Of these, the Cape, in which the principal town of the settlement is contained, although the smallest in extent, is by far the most populous and productive. Besides the peninsula,[*] it includes the country lying north of Table bay, as far as the mouth of the Berg River in St Helena-bay, being about eighty miles in length, and twenty-five in breadth, and containing nearly 2000 square miles. Scarcely a fifteenth part, however, of its surface is under cultivation, and its most valuable productions are chiefly confined to the vicinity of the town. There, most of the European, and many of the tropical fruits, are cultivated with great success. Oranges, peaches, apricots, figs, grapes, guavas, pomegranates, quinces, and medlars, are very plentiful and good. Apples and pears, though they are abundant, are generally inferior in quality to what might be expected, probably from want of attention in propagating the best sorts. Almonds, walnuts, chesnuts, and excellent mulberries, grow in great abundance. Strawberries are to be found ripe throughout the whole year; but raspberries, though tolerably good, are very scarce. The market is always well supplied with vegetables of every description, and the choicest fruits, both green and dry. The sweet luscious wine known in this country by the name of Constantia, is made at two vineyards about eight miles from Cape Town, which produce annually from ten to fifteen thousand gallons; wheat, barley, and pulse, are cultivated throughout the district. The plains of the Cape peninsula are variegated with the most elegant and beautiful shrubs and flowers, and furnish an endless field to the researches of the botanist. The bulbous-rooted plants exceed in variety those of any other country; and, at the conclusion of the rainy season, the verdant carpet of trifolium melilotos, which covers the west shores of Table-bay, is enlivened with myriads of the large othonna, among which are intermingled the oxalis cernua, hypoxis stellata, ixia, iris, amaryllis, and geraniums of every species, exhibiting the most beautiful variety of foliage and colours. Extensive plantations of the protea argentea, or silver tree, the white poplar, and the stone pine, stretch along the foot of the Table Mountain; and most of the country houses are adorned with avenues of oak. But the timber of these is of small value, being generally shaken and unsound, from its rapid growth, and is seldom used for any other purpose than fuel, which at the Cape is extremely scarce. The fuel, however, which is now chiefly derived from the cultivated woods of *Protea argentea*, the oak, and the spontaneous productions of the neighbouring country to the Cape Town, is likely soon to become very scarce, if effectual means are not adopted to ensure the plantation of trees for future supplies.

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* In Canada, however, the range is infinitely greater; on the 18th January 1810, the thermometer, about six P. M. was wavering from 34° to 32°; at three A. M. next morning, the cold was intense, and the mercury stood about 15° below 0°; and at eight A. M. on the 20th, it had sunk to 33° below 0°; yet no malady ensued that could be ascribed to it.

The colonies of *Stellenbosch* and *Drakenstein* stretch from Cape l'Aguillas, the most southern point of Africa, to the river Koussie on the north, an extent of 380 miles; its mean breadth from east to west being about 150, and its contents nearly 55,000 square miles. Though the greater part of this immense surface be barren and unprofitable, consisting merely of naked hills and Karroo plains, the subdivisions which lie on the western side of the mountains between False bay and Elephant's River, constitute the most valuable possessions in the colony. The extensive valley of Drakenstein is well inhabited, and enjoys a most delightful climate, and its soil is capable of every species of agriculture. Very little corn, however, is cultivated here. Grapes, and various kinds of fruit, are the chief productions of this part of the country, being not only the best adapted to the soil and climate, but the most profitable, from the vicinity of the capital; two thirds of the wine which is brought to Cape Town is supplied by the vineyards of Drakenstein alone. The divisions of East Zwartland and Twenty-four Rivers are equally productive, and are considered as the granaries of the Cape. Wheat and barley are their principal articles of cultivation; but the crops depend so much upon the rains, that the profits of the farmer are precarious and uncertain. The country on the other side of the mountains consists chiefly of pasture farms, and the Roggeveldt, or rye-grass country, furnishes the largest and strongest breed of horses in the settlement. The principal villages of this district are, the Drosdy of Stellenbosch, the residence of the Land-droost, which is about twenty-five miles from the Cape, and consists of nearly seventy houses, most of which are very neatly built, and have out-houses and gardens attached to them; and the *Paarl*, or *Pearl*, (a village so called from a large mass of granite lying in its neighbourhood, which bears the name of the Pearl,) which lies twenty miles farther north, at the bottom of a hill, and contains about thirty habitations, surrounded with orchards, vineyards, and gardens, forming a street from half a mile to a mile in length.

Zwellendam comprehends the belt of country lying between the Black Mountains and the sea, and extends from the Breede River on the west, to Camtoos River on the east. Its length is about 380 miles, and its breadth from north to south 60, including an area of 19,200 square miles. The general aspect of this district, exhibits a greater variety of surface, and is more diversified by hill and dale than any other part of the colony. The mountains near the sea are clothed with impenetrable forests, and many of the plains abound in the common aloe, which constitutes a considerable article of commerce. The pasture in general is excellent in this district, but it is deemed by the Dutch farmers to be better adapted for horses than for oxen or sheep. The revenues of the farmer are derived from the sale of horses, timber, grain, butter, soap, and dried fruits. In the division of Autiniquas Land, a little east of Mossel-bay, the Dutch government reserved for itself about 20,000 acres of the most fertile land, consisting of an extensive meadow, which was always covered with the most luxuriant verdure. This is cultivated by an overseer, and is calculated to furnish annually 10,000 muids of corn, besides affording sufficient maintenance for 1000 horses, and as many cattle. The village of Zwellendam is composed of about thirty houses, scattered irregularly over a fertile valley. It contains the house of the Land-droost, and the only church in the district.

Graaf Reynet includes the tract of territory lying between the Gamka or Lion river on the west, and the Great Fish river on the east; and is bounded on the north by the country of the Bosjesmans, and on the south by the Black Mountains and the sea. Its mean length is 250, and breadth 160 miles, comprehending an area of 40,000 square miles. Little grain is sown in this district, except what is necessary for the subsistence of the inhabitants, and this is very inconsiderable, as many of the inhabitants live entirely upon animal food. The difficulty of transportation to market, and the devastation of the locusts, which particularly infest the division of Sneuwberg, renders it a very unprofitable article of cultivation. Sheep and horned cattle are reared in great perfection, particularly the former, which thrive so well here, that the ewes very frequently produce lambs twice in the year. Perpetual hostilities are carried on by the Dutch boors who dwell near the boundaries of the colony, with the Caffres and Bosjesman Hottentots. Graaf Reynet is the only village in this vast district, which bears its name, and even that contains little more than a dozen of small houses, the walls of which are constructed of clay, dried by the intensity of the heat into a solid mass, sufficiently strong to bear a thatch roof. This small village, which is the residence of the Droost, or chief magistrate of the district, is, exactly as we might expect the rudiments of a town to be, inhabited by a blacksmith, a carpenter, and some other mechanics, who are employed by the boors, (or peasants,) on their visits to the seat of government. It also contains the only place of public worship in the district.

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[*] It is a prevailing hypothesis among authors, that the Cape Peninsula must have been originally separated from the continent of Africa; and Lord Valentia affirms, without hesitation, that the Isthmus between Table and False Bay was formerly covered by the sea. Mr Barrow, however, thinks otherwise, and is decidedly of opinion that the sea is rather encroaching upon the land than retreating from it, and that the whole of L'Aguillas bank, stretching from Cape Point across the entrance of False Bay to the mouth of the Great Fish River, has once formed a part of the continent. See his *Travels*, vol. ii. p. 63.

In the southern part of this district, a little west of the Sunday river, is one of those salt water lakes which abound in Southern Africa, and which are called *zout pans*, or salt pans. It is about three miles in circumference, and is the most extensive in the country, and resorted to by the inhabitants of very remote parts, in the summer, for their yearly supply of salt. It is situated in the midst of a wood of frutescent plants, at a considerable elevation above the level of the sea. The salt which is taken out for use is broke up with picks, and is between four and five inches thick; and during the dry south-easterly winds of summer, the agitation of the water produces on the margin of the lake a fine powdering salt, like flakes of snow, which is equally beautiful with the refined salt of England.

On the banks of the Fish river in Voor Sneuwberg, or the fore part of the Snow Mountain, are two hepatic wells, of the temperature of 88° of Fahrenheit, which are visited by the sick, and held in as high repute as the mineral springs of any country, however civilized, for their virtues in curing rheumatic disorders of every kind and degree, cutaneous eruptions, sprains, bruises, and all other bodily ills that flesh is heir to.

This short sketch of the different districts may not be improperly succeeded by the following table, which contains an exact statement of the extent, stock, produce, and population of the whole colony, as taken from the *Opgaaf* * lists of 1798.

		Cape.	Stellenbosch.	Zwellendam.	Graaf Reynet.	Total.
Extent of surface (in square miles)		2,000	55,000	19,000	40,000	116,000
Land under cultivation (in English acres)		7,338	39,146			
STOCK IN PRODUCE.						
Horses		8,334	22,661	9,049	7,392	47,436
Horned cattle		20,957	59,567	52,376	118,306	251,206
Sheep and goats		61,575	51,695	154,992	780,274	1,448,536
Hogs		758				758
Wine plants		1,560,709	11,500,000			13,060,109
† Leggers of wine		786½	7,914	220½	$187\frac{5}{10}$	$9,108\frac{5}{10}$
‡ Muids of wheat		32,962	77,063	16,720	11,283½	138,028½
Do. of barley		18,819	32,872	10,554	5,193¼	67,438¼
Do. of rye		529	2,053			2,582
POPULATION.						
Families	Christians.		1,200	480	700	
Males		3,017	3,815	2,041	2,110	10,983
Females		3,012	3,017	1,626	1,827	9,482
Servants and people of colour		232	424	300	325	1,281
Slaves		11,891	10,703	2,796	964	25,754
Hottentots			5,000	500	8,947	14,447
Total inhabitants		18,152	22,959	6,663	14,173	61,947

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* The Opgaaf is an annual statement of the number of his family, the amount of his live stock, and the produce of his farm, which every householder is obliged by law to make to government. It was formerly given without any regard to accuracy; but since the capture of the settlement by the British in 1795, it has been required upon oath. In the above returns, however, the British army and navy, and British settlers, are not included.

† A *legger* is nearly the same as our pipe, and contains 160 gallons.

‡ The *muid*, or sack, is equal to $3\frac{1}{10}$th Winchester bushels, and usually weighs 180 Dutch pounds.

This extensive colony is in no circumstance more worthy of notice, than in the wonderful variety of animals which inhabit its varied surface of mountain and valley, wood and Karroo plains. Amongst these are to be mentioned, the lion, the elephant, the rhinoceros, the buffalo, the hippopotamus, the leopard, panther, hyæna, wolf, jackal, tiger-cat, the zebra, the quachas, the gnoo, and the numerous family of antelopes, from the stately eland or elke, to the pigmy antelope. From the increase of population, however, the antelope, together with every other sort of game, has gradually become more scarce; and some species are extirpated from parts of the country in which they abounded. The spring-bucks still traverse the plains of Graaf Reynet in flocks, consisting of many thousands. The gnoo, whose generic character is so indistinctly marked, or, we may more accurately say, the gnoo, which possesses those characteristics by which naturalists have thought proper to draw limits between the families of nature, and have by them been assigned to different families, is one of the most beautiful animals that have been found in Africa, to whatever genus he may belong. His head bears some resemblance to that of the African buffalo; he has an erect mane, and a mane, if we may call it so, under the neck, descending from the breast between the fore legs; his shoulders and body are somewhat like those parts of the horse; while he has the elegant limbs of the antelope. But he has what he ought not to have had, if he had been a good naturalist,—he has the *subocular sinus*, which, by all the laws of natural history, is the exclusive property of antelopes. There are also several species of hares; and in the mountains to the eastward is found the *das*, or rock-rabbit, with short ears and no tail. Among the birds are eagles, vultures, kites, pelicans, flamingos, spoon-bills, cranes, ibises, wild geese and ducks, teals, snipes, quails, bustards, and partridges. Turtle doves, of many sorts, thrushes, humming birds, and an immense variety of other small birds, of the most exquisitely beautiful plumage, are found in the woods. Ostriches in considerable numbers inhabit the Karroo plains: their eggs are less strong in taste than the eggs of ducks or geese. It is a remarkable peculiarity in the natural history of the ostrich, that it not only is gregarious, in the ordinary sense of the term, but it very often happens that two or three females deposit their eggs in a common nest, and incubate together, attended by the fathers of the brood. It is not unusual to find thirty-six eggs in a nest, the common stock of three females. Along the coast are various kinds of sea-fish, such as perches, stone-breams, rockfish, mackerel, soles, and skate; and abundance of muscles and oysters. The domestic animals of the Cape are not numerous, as none are reared but what are absolutely necessary. Their horses are not indigenous, but were first introduced from Java. Those from South America, however, are preferred, both for their beauty and hardiness; and though small are capable of sustaining great labour. A scientific English breeder would say, that the oxen at the Cape run to waste too much in their make, that is to say, they have long legs, long horns, and high shoulders. The sheep are remarkable for their broad, flat and massy tails, usually weighing about six pounds, though, in some rare instances, they have amounted to 14; they have long legs, pendulous ears, and a small scraggy neck. The wool is hairy, and of no value: but that of the mixed breed of Spanish and English, which was first introduced into the colony by Colonel Gordon, is very beautiful, and might be rendered a very profitable article of commerce. The African goat is a very prolific and valuable animal. Hogs are almost unknown, and poultry is very scarce.

The colonists of this settlement are divided into four classes, viz. the inhabitants of the Cape Town, consisting of the civil servants of government, those engaged in commerce and the arts; the cultivators of the vine; the grain farmers, and the graziers.

The culture of the vine requires a greater capital than the other two branches of husbandry, from the labour necessary in pruning and dressing it, as well as the expensive utensils requisite for making wine, consequently the wine makers are the most opulent. By their vicinity to the town, and their frequent excursions thither with the produce of their vintage, they have an opportunity of procuring many comforts, which the boors in the eastern districts of the colony have not the means of obtaining. Many of them are descended from the French families, who took refuge here from the religious persecutions of their bigotted countrymen upon the revocation of the edict of Nantes, and were the first who introduced the vine into this country. They still retain some of the peculiarities of their nation. They are more social and communicative than the Dutch; visit one another with great familiarity, or take a summer jaunt into the country in their tent waggons drawn by a team of six or eight horses. Their houses are in general well built, and their domestic affairs are managed with considerable economy and cleanliness. The produce of their farm, which invariably exceeds their annual expenditure, enables them to support a style of living comparatively affluent. Their only public burdens consist in a small capitation tax for repairing the streets and avenues leading to Cape town, and the lion and tiger money for the exigencies of the district. The former of these, however, is either very ill applied, or very insufficient for the purpose, as the roads over the Cape isthmus are so wretched, that it requires fourteen or sixteen oxen to draw two leggers of wine, about 2½ ton weight. The tax upon their produce is also very moderate, being three rix-dollars for every legger of wine or brandy that is brought to the Cape market. All that is consumed at home, or sold to the other boors, is duty free. The grain farmers are next in rank and civilization to the wine-growers; and chiefly inhabit the districts near the town, from which they are seldom distant more than two or three days journey. Many of them are in easy and even affluent circumstances. They have not much intercourse with each other. Seldom, indeed, are they agreed about the boundaries of their respective properties; and the privilege of a spring or a water-course, is often a fertile source of quarrel and litigation. This continual jarring is a great impediment to general improvement. The men of this class are in general very tall and corpulent, but loose in their joints, clumsy, and awkward. Cold and phlegmatic in their temper, and never raised to exertion by the fear of want or the desire of gain, their lives are spent in the most listless inactivity. The same indolence extends to the women. The mistress of the family remains fixed to her chair, with a coffee-pot constantly boiling before her, from morning to evening, as if she constituted a part of the furniture; and her daughters sit beside her, equally indolent and idle. The year is varied by no incident that can awaken their anxiety or their hopes. They have no fairs, no visiting parties, no dancing, no music nor amusement of any sort. The history of a day is the history of their whole lives, and their only topics of conversation are, a journey to the city or church, a marriage, and the depredations of the locusts and Bosjesmans. Their style of farming is miserable in the extreme. The land is merely scratched with a huge unwieldy plough, drawn by eight horses, or a dozen of oxen. A rude harrow follows the sower, which always leaves the field in a rougher state than the coarsest lea-ploughing in Britain. They use no manure, except a little for barley, though the *kraals*, or pens, in which their cattle stand are as full of dung as the stable of Augeus; and after this wretched preparation, they calculate upon a return of fifteen fold. In low situations, near rivulets, where they have a command of water, they usually reap from thirty to forty for one. Their public burdens are the same as those of the wine-growers; and the duty upon the grain which is carried to Cape town amounts to nearly a tenth of its value. The graziers are by far the rudest of the Cape colonists, and can scarcely be said to be superior, either in intelligence, in manners, or in comforts, to many of the uncivilized hordes of savages that surround them; many of them, especially towards the northern and eastern boundaries of the settlement, have no fixed habitations, but wander about from place to place, and sleep with their families in waggons, or build temporary reed huts like the Hottentots. Those even who are stationary are scarcely better accommodated. Their huts being only destined for temporary accommodation, until a fountain dries up, or their flocks have consumed the pasture in its neighbourhood, are generally constructed of clay baked in the sun, or sods, covered with a thatch of rushes, carelessly put together, rarely water-proof, and protected only by a door of reeds matted together. They have seldom more than one apartment, and here the peasants, with their children, and the house Hottentots, are huddled together during the night. The master's bed, which is an oblong frame of wood, standing on four feet, and reticulated with thongs of undressed leather, which supports a wool mattress or feather bed; a great chest which contains all their moveables, and serves for a table; a few chairs, and a large iron pot, for preparing their provisions, are their principal articles of furniture. The dress of the men consists of a blue shirt, leather pantaloons, a broad brimmed hat, and a pair of shoes of raw hide. The women have a short jacket and petticoat, a thick quilted cap tied under the chin and falling down upon the shoulders, no stockings, and seldom shoes. Their principal food is mutton, which is served up three times a day. They have very little milk and butter, and but few vegetables. The master carves the meat with a large pocket-knife, and then every one helps himself. Wine is rarely seen at their tables, though they live in the midst of a soil and climate most favourable for the cultivation of the grape. A glass of strong ardent spirits is the favourite debauch of a Dutch African Boor, and his greatest luxury is his pipe, which never quits his mouth except when he eats or sleeps. Such are the comforts and situation of many a peasant who possesses several thousand sheep, and as many hundreds of cattle. Indolence is the predominant feature in his character. It is only by the most urgent necessity that he can be brought to exert himself, even for his own convenience or interest. But though indolent in what concerns his own comfort, he is active in oppression towards the miserable Hottentots who are under his authority. Of these helpless beings, each family in Graaf Reynet possesses, on an average, about thirteen, who are, in general, treated with the most brutal inhumanity. The most trifling fault is visited with the severest punishments. The husband is frequently separated from his wife and children, and driven from his habitation, is compelled to join his persecuted, but still independent countrymen, among the mountains.[*] Their cruelty is also extended to the Caffres and Bosjesmans, with whom they are almost constantly at war. From the latter of these, however, they often experience the most terrible retaliation; and, consequently, the murder of one of them is proclaimed by the Dutch as a most meritorious action. "A boor from Graaf Reynet," says Mr Barrow, "being asked in the secretary's office, a few days before we left the town (Cape,) if the savages were numerous or troublesome on the road, replied, he had only shot four, with as much composure and indifference as if he had been speaking of four partridges. I myself have heard one of the humane colonists boast of having destroyed, with his own hands, near three hundred of these unfortunate wretches."

Many of the farmers in the eastern parts of the settlement can neither read nor write. Their ignorance, however is more to be lamented than to be wondered at, when the means of instruction within their reach are considered. The habitations are too widely scattered over the country to admit of the establishment of public schools; and the means of individuals are too circumscribed to admit of their hiring competent teachers in their families; for who, that had received a tolerable education, would bury his knowledge in the hut of an African peasant, whose supply, even of the necessaries of life, are often but scanty. A disbanded soldier, who had served the Dutch long enough to obtain his stipulated discharge, generally becomes the preceptor of a Boor's children; and he is frequently paid for his instructions in sheep and clothing. If sober, which is not always the case, he amasses enough to become a farmer himself. The principal occupation of the greater part consists in learning to shoot, to drive a waggon, and to crack and use with dexterity an enormous whip. Notwithstanding their ignorance, however, they all affect to be very religious; and, though their religion seems to have very little influence in awakening feelings of benevolence and humanity towards their fellow-creatures, they are scrupulously exact in the observance of its forms. They are regular in their attendance at church, though it costs some of them a journey of several days; and such as are a fortnight or three weeks journey from the nearest place of worship, generally go with their families once a year. They always begin their meals with a long grace, pronounced by the youngest of the company; and every morning, before day-light, one of *William Sluiter's Gesanger*[*] is sung by the whole family. Having enumerated those depravities which tarnish the character of the African Boor, we turn with pleasure to a more amiable part of his character, the hospitality which he cheerfully exercises to those strangers who visit his abode. His door is open to all who come; and, without a question being asked, the stranger is invited, in the laconic style of Dutch politeness, to enter. He is made welcome to his share of the repast, to a bed, or to a part of a bed, if the house only affords that accommodation; and "in the morning," says Mr Barrow, "after a solid breakfast, he takes his glass of brandy, orders his slave, or Hottentot, to saddle the horses, shakes hand with the men, and kisses the women; *he* wishes them health, and *they* wish him a good journey. In this manner a traveller might pass through the whole country."

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[*] Many and most shocking instances of barbarity inflicted upon this unfortunate race, are recorded in a pamphlet published at the Cape during the last peace, by Baron de P——, private secretary to Governor Jansens. Among these, is an account of the murder of fifteen innocent Hottentots, who, having come to a farm to beg some hemp and tobacco, were inhumanly tortured in order to extort a confession that they were come with an intention to plunder the colonists, and afterwards shot; and another, equally brutal, of which we give the following translation: "As soon as the English had abandoned the fort, (at Algoa Bay,) a boor named Ferrara, of a Portuguese family, made himself master of it, and kept possession till the arrival of a detachment of troops which government sent thither, under the command of Major Von Gelter The Caffres, fully persuaded that the late peace had put an end to all disturbances between them, sent to the new commander of the fort a bullock, to be slain as the test of reconciliation and friendship. The Caffre sent on the occasion put himself under the guidance of a Hottentot; and Ferrara, by way of returning the kind intention, laid hold of the Caffre, and *broiled him alive;* bound the poor Hottentot to a tree, *cut a piece of flesh out of his thigh, made him eat it raw,* and then released him."

Under such a climate, where the means of subsistence are so easily produced, where the country is but thinly inhabited, and the habitations are so distant from each other, and so far removed from the seat of government, as often to place their tenants beyond the reach of law, we are not surprised to find, that the vicious propensities have too often predominated over those of the opposite character, in men who have not originated from the Dutch, or from any common source, but have sprung from most of the nations of Europe. When they committed crimes, the threatenings of a distant and feeble authority, without the power of putting them in execution, served rather to encourage than to deter them from prosecuting their schemes of plunder; and the only hardship resulting from their disobedience, was their being debarred from visiting the Cape. Thus many of them became perfect robbers, and lived in a state of almost constant hostility with the surrounding tribes. Liable to be attacked in their turn, they were compelled to wander from place to place, and to be continually on the watch: thus deprived of many comforts and conveniences which a state of peaceful society affords, and habituated to scenes of cruelty inseparable from such a warfare. Those who afterwards became stationary, did not think of renewing those comforts to which they had been long unaccustomed, and were content with little more than the bare necessaries of savage life. The same system of plunder still continues in some of the distant parts of the colony; and many of the boors are under sentence of outlawry, on account of their depredations and disobedience.

The tenures under which the colonists hold their lands in this settlement, are of four descriptions, viz. loan lands, gratuity lands, quit rents, and freeholds. The first of these is the most ancient, and consists of certain portions of land granted to the early settlers, upon condition of paying to government an annual rent of twenty-four rix-dollars. Each of these is supposed to contain about nine square miles; and, though the lease was at first made out only for one year, yet the payment of the rent was considered as a renewal; and, consequently, this tenure is nearly similar to a lease held in perpetuity. Gratuity lands are those which were originally granted in loan, but have been since converted into a kind of customary copyhold, liable to an annual rent of twenty-four rix-dollars. Quit rents arise from pieces of waste land occupied by the owners of the estates to which they are contiguous, upon a lease of fifteen years, and at an yearly rent of one shilling per acre. Freeholds are such lands as were granted to the original settlers, in small portions of 120 English acres, and consist of the finest land in the colony. They are chiefly confined to the Cape district, and its vicinity.

The commerce of this settlement under the Dutch, was confined almost entirely to such ships as touched at the Cape for refreshments; and a scanty supply of a few European and Indian commodities for the immediate use of the colony. These, however, were allowed to be brought only in Dutch bottoms, all traffic with the other nations being considered as contraband; and such was the tardiness with which they were furnished, that the inhabitants were sometimes compelled to smuggle certain articles out of foreign vessels for daily consumption. The original design of its occupation, was merely as a point of communication between their Indian settlements and the mother country; and, though it was afterwards used as a military depot, for forming and preparing their troops for warmer climates, yet it has never been able to profit by the advantages of its situation. Were the absurd regulations, and jealous restrictions, with which it has been so long fettered, completely abolished, and the trade of our Indian empire thrown open to all British outports, the Cape might rise to be one of the first commercial cities in the world. Placed at almost an equal distance from India, Europe, and America, it would soon become an emporium for the manufactures and produce of each of these countries, and an influx of active settlers would raise it to be a most valuable colonial possession. It would not only open an extensive market for British merchandise, but it might be rendered a granary capable of affording us almost unlimited supplies during a scarcity. Little, however, can be expected from its present inhabitants, whose indolence has been fostered by the restrictive regulations of the government, which seems to have thrown every impediment in the way of its becoming a flourishing settlement; and, consequently, a statement of its present trade, cannot be considered as any estimate of its real importance. Its principal articles of exportation consist of grain, pulse, wine, brandy, hides, skins, dried fruits, aloes, and ivory. The quantity exported, however, is very inconsiderable; and, during the last four years in which the settlement was in possession of the British, from 1799 to 1802 inclusive, the total value of colonial exports amounted only to 300,925 rix dollars, or 60,185*l.* currency; and its re-exportation of foreign commodities to about 170,000*l.* Of 131,361½ muids of wheat, which passed the barrier during that period, and paid duty, 30,000 muids were annually required for the consumption of the inhabitants of Cape Town and the army and navy; so that the average annual surplus which could be spared for ships calling for refreshments, was less than 4000 muids. The wine and brandy which passed the barrier in four years, amounted to 21,649½ leggers of the former, and 1665½ of the latter. Of these, the average quantity annually exported was about 600 leggers of wine, besides 23 of Constantia, and 60 leggers of brandy, estimated at 50,000 rix-dollars. The annual exportation of aloes was 85,482 lb. valued at 6416 rix-dollars; that of hides and skins amounted to between 5000 and 6000 rix-dollars; of dried fruits, in 1802, to 2542 rix-dollars; and of ivory to 1585 rix-dollars. Besides these articles of colonial growth and produce, which this settlement, if properly managed, could furnish to almost any extent, it is capable of supplying several others equally valuable, and in equal abundance, particularly tobacco, wool, salt provisions, whale oil and bone, and soap.

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[*] Songs from the Bible, done into verse by William Sluiter, the Sternhold and Hopkins of Holland.

The limited exportation of this colony, however, does not at all regulate the quantity of its imports. In most countries, it is according as the one or the other of these preponderates, that we estimate their poverty or wealth: But in the Cape settlement, though its exports scarcely amounts to one-fifth of its imports, a considerable balance is drawn in favour of the colony, which, however, is occasioned entirely by the consumption of the garrison and navy. The principal articles of importation from Britain, consisted in woollen cloths, Manchester goods, hosiery, haberdashery, millinery, boots, shoes, hats, cutlery, iron tools, stationary, bar and hoop iron, smiths' coals, household furniture, paints, oils, earthenware, naval stores, tongues, hams, cheese, and pickles; from India and China were brought piece goods, tea, coffee, sugar, pepper, spices, and rice; from America, deal planks, staves, balk, salt fish, pitch, turpentine, &c.; and from Denmark, Sweden, and Hamburg, assorted cargoes of iron, plank, French wines, beer, gin, Seltzer water, coffee, preserves, pickles, &c. An abstract account of the whole importation is contained in the following table:

	1799		1800		1801		1802		In four years.	
IN BRITISH VESSELS.	Rix-dollars	sk.	Rix-dollars	sk.	Rix-dollars	sk	Rix-dollars.	sk.	Rix-dollars.	sk.
British goods, duty free - - -	674,009	6	474,706	0	587,023	4	532,366	4	2,268,105	6
Indian goods, 5 per cent. duty - -	104,124	0	212,446	0	290,117	0	455,397	4	1,062,084	4
European prize goods, do. - - -	20,623	5	17,797	0	568,425	0	93,788	2	700,633	7
Indian prize goods, 10 per cent. duty	100,487	0	45,335	0	129,642	6	130,729	6	406,185	4
Prize slaves, and others - - - - -	245,600	0	184,000	0	271,200	0	198,205	0	899,005	0
IN FOREIGN VESSELS.										
European and American goods, 10 per cent. duty - - - - - - -	118,244	0	51,258	0	136,394	5	142,684	6	448,581	3
Indian goods, do. - - - - - - -	64,219	6	109,490	0	3,337	2	15,892	7	120,939	7
Amount - - -	1,327,308	1	1,095,032	0	1,986,140	1	1,569,055	5	5,977,535	7
Total importation - - -	5,977,535	7	rix-dollars, or 1,195,507*l.* 3*s.* 6*d.* currency.							

This immense preponderance of imports, Mr Barrow disposes of in a very satisfactory manner. He supposes that the army, independent of the clothing and stores, &c. sent from home, and money remitted by the officers, could not expend less, in European and Indian goods, and colonial produce, than 180,000*l.* per annum, which

in four years is - - -	*L.*720,000	0	0
The navy expenditure might, perhaps, amount to half that sum,	360,000	0	0
The re-exportation of India prize goods, and of European goods to the West India islands, the coast of Brazil, and Mozambique, in four years, about	170,000	0	0
Surplus colonial produce exported, as above - - - -	60,185	0	0
	*L.*1,310,185	0	0
Value of imports, as above -	1,195,507	3	6
Balance in favour of the colony, and merchants residing there,	*L.*114,677	16	6

According to the books of the custom-house, and the returns of the captain of the port, the vessels which sailed from the Cape amounted,

In 1799 to 103;
1800 109;
1801 130;
1802 131;

Total, 473 ships.

Of these, 82 were Americans, 66 Danes, 24 Portuguese, 6 Swedes, 15 from Hamburgh, 4 from Prussia and Bremen, and the rest English.

While this settlement was subject to the Dutch East India Company, its revenue was never adequate to the contingencies and extraordinary expences of its government, and it was retained merely as a place of refreshment for the outward and homeward bound India ships, which they considered as an ample compensation for the annual expenditure of 300,000 guilders. In 1770, the deficiencies in the receipts for defraying the expences of the colony amounted to 26,768*l.* 11*s.* 3*d.* sterling, being nearly two-thirds of the expenditure; and in 1779 it was increased to 28,191*l.* The average revenue from 1784 to 1794 was about 100,000 rix-dollars yearly; but, by the new regulations and imposts of the Dutch commissaries general in 1793, it was raised to 211,568 rix-dollars; which was farther increased to 450,713 during the last year of Lord Macartney's administration, while the settlement was in possession of the British, without a single additional tax having been laid upon the inhabitants. The public revenue of the colony arises from the following sources, to each of which we have affixed the amount for 1801.

	1801.		
Branches of Revenue.	Rix-dollars.	sk.	st.
Land revenue, - - - - -	47,885	6	4
Duties on grain and wine levied at the barrier, - - - - -	37,759	3	0
Transfer duty on sales of immoveable estates, - - - - -	67,483	7	0
Duty arising from sale of buildings on loan estates, - - - - -	5,247	5	1
Public vendue duty, - - - -	85,960	2	4
Fees received in the secretary's office, - - - - - -	1,312	7	0
Customs, - - - - - - -	47,833	1	0
Port fees, - - - - - -	5,498	0	0
Postage of letters, - - - - -	1,396	6	0
Seizures, fines, and penalties, for contraband, - - - - -	5,533	3	0
Licences to retail wine, beer, and spiritous liquors, - - - -	93,200	0	0
Interest of the capital lent out through the Loan Bank,[*] - -	25,957	0	1
Duty arising from stamp paper, -	25,645	1	0
Total amount rix-dollars	450,713	2	4
Or,	*L.*90,142	13	4

The supreme government of this colony is vested by the king in a governor or lieutenant governor. Each district is placed under the authority of a Land-droost, assisted by a council of burghers, six in number, called the Heemraaden. The office of Land-droost is somewhat similar to that of sheriff of a county in Scotland. The person filling that station is not only at the head of the police of his district, but presides in the provincial court, with authority to hear and decide civil actions, where the sum contended for does not exceed 150 rix-dollars, and to try such criminal suits as do not infer a capital punishment. His decisions are open to appeal, and subject to the revisal of the court of justice in Cape Town. The court of justice is composed of a president and six judges, appointed by the governor, forming a court of competent jurisdiction, to try all causes civil or criminal that may be brought before them, deciding by plurality of votes, as a special jury. An appeal lies from their judgment to the court of appeals, in which the governor or lieutenant governor decides upon a statement of the case agreed upon by parties before the inferior court; and from the decision of the court of appeals, an action may be carried in appeal before the king and council. The legal proceedings are regulated by a code of laws, emanating from the Dutch East India company, called the *Statutes of India*, founded upon the basis of the civil law, and drawn up expressly for the jurisprudence of their possessions in the East. Beside the statutes of India, the proclamations of the governor were considered as laws, and were supposed to relate to such circumstances as were in their nature only local or temporary.

In Cape Town there is also an inferior court for the summary decision of petty suits, consisting of a president, vice-president, and four members: it is the duty of this court to grant licenses to parties intending to marry, without which no clergyman is authorised to perform the ceremony.

There is an excellent institution here, called the Wees-kammer, or Orphan Chamber, appointed by government for administering the affairs of orphans and minors. This board is composed of a president, secretary, and four members. The fiscal is president *ex officio.* Private executors are by law allowed 5 per cent. for their trouble, and property sold by them is liable to a tax of five per cent.; whereas the property managed by the Orphan Chamber is exempted from the tax on the transfer of immoveable property, and is charged 7½ per cent., consequently 2½ per cent. are saved to those interested, in addition to the security derived by the most helpless part of the community, from having their effects vested in the charge of a public college established by law, instead of becoming victims to ignorance, to misfortune, or to fraud. The fiscal is the attorney general and public prosecutor in all criminal cases. He is also the chief magistrate of police, and in this capacity has authority to inflict corporal punishment upon such of the inhabitants as are not burghers for petty offences, and is empowered to impose fines and accept pecuniary compositions for misdemeanors, and where the offender does not wish to risk a public trial. This power was formerly subject to most enormous abuses; but the British government limited the sum that could be demanded, in cases of compromise, to 200 rix dollars.

Although Calvinism is the established religion in the settlement, there are many Lutherans. The ministers are paid entirely by the government; and there is no country in which this useful body are more highly respected. They hold the next rank to the president of the court of justice in town, and to the Land-droost in the country. The poor's funds accruing from donations at the church door, legacies, and also from a tax upon the emancipation of slaves, are entirely under their management. In 1798, the funds belonging to the established church amounted to 22,168*l.* 8*s.* 8*d.*, and the relief granted to the poor was 1112*l.* 17*s.*; those of the Lutheran church were 14,829*l.* 13*s.* 2*d.*, and the poor received 194*l.* 9*s.* 2*d.* In the district of Stellenbosch, at a place called Bavian's Kloof, is an establishment of Moravian missionaries, who, about ten years ago, had collected into one society more than six hundred Hottentots, whom they not only instructed in the Christian religion, but taught several useful trades. Each family possessed a small hut, with a patch of ground for raising vegetables; and by the example and persuasion of these good fathers, had become both cleanly and industrious. "The deportment of this Hottentot congregation during divine service," says Mr Barrow, "was truly devout. The discourse delivered by one of the fathers was short, but replete with good sense, pathetic, and well suited to the occasion: tears flowed abundantly from the eyes of those to whom it was particularly addressed. The females sung in a style that was plaintive and affecting; and their voices were in general sweet and harmonious. Not more than fifty had been admitted as members of the Christian faith by the ceremony of baptism. There appeared to be no violent zeal on the part of the fathers, which is the case with most other missionaries, to swell the catalogue of converts to Christianity, being more solicitous to teach their trades to such as might choose to learn them. Adopting the idea of the humane Count Rumford, their first great object seemed to be that of making men happy, that they might afterwards become virtuous, which is certainly much sounder philosophy, than the reverse of the proposition."

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[*] The Loan, or Lombard Bank, was established by the Dutch government, with a view of increasing their revenue, while, at the same time, they appeared to confer a favour upon the colonists. The acquired capital was about 680,000 rix-dollars; and paper money was issued as a loan to individuals, on mortgage of their lands and houses, with the additional security of two sufficient bondsmen, at 5 *per cent.* being 1 *per cent.* less than the legal interest of the colony According to its regulations, the loan was never to exceed half the value of estates in town, and two-thirds of estates in the country; and, at the expiration of two years, the directors could either call in the loan, or prolong it, as they thought proper. The sum issued was at first confined within the amount of the capital, but was afterwards increased to near one million rix-dollars.

In the history of this settlement, there are few circumstances deserving of very particular attention. Its conquest was accomplished without bloodshed, and its natives have hitherto opposed but very feeble resistance to their European oppressors. The lofty promontory of the Cape was first discovered by Bartholomew Diaz, an eminent Portuguese navigator, in 1487, and named by him *Cabo Tormentoso*, or the Stormy Cape, on account of the boisterous weather which he experienced near the coast, and which, with the shattered condition of his ships, and the mutinous disposition of his crew, prevented him from doubling it, or making the land.* His sovereign, John II. however, gave it a name of more propitious import, and called it the Cape of Good Hope, thereby expressing his sanguine expectation, that the long wished for passage to India had now been found. These expectations were indeed completely fulfilled in 1497, by Vasco de Gama, who, having touched at the Cape, passed to the coast of Malabar. The Portuguese, in their subsequent visits to this country, made several attempts to establish a colony, but they all failed; and nearly a century and a half was allowed to pass, before any European power had formed a permanent settlement on its shores. During this period, the English and Dutch frequently touched at the Cape for refreshments on their way to India; and it was the general custom to leave dispatches for their respective directors, buried in a certain spot, which were taken up, and carried home by returning vessels. The Dutch, however, at last began to discover the advantages which such a position would afford to their India trade, both as a point of communication and refreshment; and upon the favourable representations which Van Riebeck, then a surgeon in one of the Dutch ships, gave of the mildness of the climate, and the fertility of the soil, resolved to form a regular establishment. This resolution was carried into effect in 1650, under the direction of Van Riebeck, who, having concluded a treaty with the natives, took possession of the Cape peninsula, and laid the foundation of the present town, by erecting a fort of wood and earth, and some other necessary buildings, which he called *Kier de Kou*, "a defence against all." This gentleman soon discovered, and took advantage of, the passion which these weak and peaceable Hottentots had for spiritous liquors; and by giving them a few casks of brandy, a little tobacco, iron, and some paultry trinkets, obtained from them a part of their country and their flocks. A piece of iron hoop was the price of an ox, and a cask of brandy the purchase of a whole district. A hundred male settlers constituted the first colony of the Cape; but these being afterwards joined by nearly an equal number of females from the houses of industry in Holland, and also by a number of French refugees, who were obliged to leave their country in 1685, its population rapidly increased. The principal difficulties which were at first experienced in the extension of the settlement, arose from the wild beasts that swarmed in every part of the country, and which committed their nightly depredations under the very walls of the fort. But these were by degrees almost completely extirpated; and, unless one ineffectual attempt of the natives to recover their lands, and to expel their oppressors, the Dutch continued without any farther interruptions, either from the Hottentots or Europeans, to extend their encroachments over the richest districts of the country, for nearly 180 years. This settlement, however, by the restrictive regulations on its commerce, though its inhabitants and territories were continually increasing, was unable to support the expence of its own government; and, except as a port of refreshment for their Indian ships, it became a burden, instead of a convenience to the mother country. Soon after the breaking out of the French revolution, the mania for liberty and equality found its way into the settlement, and serious apprehensions were entertained, lest the colonists should declare themselves a free and independent republic. A convention was established, and proscribed lists were made out, of such of the inhabitants as were to be condemned to banishment or the guillotine; and even the slaves had their meetings, and began to hail the period of their complete emancipation. The appearance of a British fleet, however, in 1795, soon put an end to these proceedings. The Dutch force was driven from the advanced posts of Simon's Town and Muysemberg by General Craig, with a very small body of the 78th regiment, aided by corps of seamen and marines, landed for the occasion from the fleet in False Bay, commanded by Sir George Keith Elphinstone; and the important advantage which had been gained was maintained in the face of a superior force by that able general, until the arrival of an army under Sir Alured Clarke, when, on the advance of the British to Wynberg, terms of capitulation were accepted of. During the seven years it remained in our possession, a wise and liberal policy had considerably increased its revenue and commerce; and, on closing the public accounts the year after the departure of Lord Macartney, the governor, a balance of between two and three hundred thousand rixdollars remained in the treasury, after defraying all the expences of the colony. By the peace of Amiens, in 1802, it was delivered up to the Batavian republic in full sovereignty; but so far declared a free port, that the ships of the British and French nations were to be allowed to enter its harbours, upon paying the same duties as those of the mother country. In 1806, it was again taken by the British, under Sir David Baird and Sir Home Popham, under whose dominion it still remains. See BRITAIN, vol. iv. p. 657. See *An Account of Travels into the Interior of Southern Africa*, by John Barrow, Esq. who, in the second volume of this valuable work, has treated at considerable length, of the value and importance of the Cape of Good Hope, as a military and naval station, as a seat of commerce, as a central depot for the southern whale fishery, and as a territorial possession; and by way of conclusion adds, "that, under the present implacable disposition of France towards this country, and the insatiable ambition of its government, Great Britain never can relinquish the possession of this colony for any length of time, without seriously endangering the safety of her Indian trade, and the existence of her empire in the East." See also Sparrman, Le Vaillant, Thunberg, and Paterson's *Travels in this Settlement;* Stavorinus's *Voyages to the East Indies*, vol. i. p. 535, &c. and iii. p. 432, &c.; Lord Valentia's *Travels*, vol. i. p. 41, &c.; Peuchet *Dictionnaire*, &c.; Semple's *Walks and Sketches at the Cape of Good Hope;* and Perceval's *Account of the Cape of Good Hope.* (*p*)

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* Some historians pretend that Diaz did land, but that he was driven from the country by the natives.

CAPE TOWN, the capital of the Cape of Good Hope, and the only place in the colony that deserves the name of a town, stands on a sloping plain at the south-west corner of Table Bay, and is surrounded, except towards the sea, by black and dreary mountains. It is a regular and neatly built town, and well watered by a plentiful stream which issues from the Table Mountain. Many of the streets are of considerable breadth, having canals of water running through them, which are walled in, and planted on each side with oaks; but others are narrow and ill-paved. They are all straight, however, being laid out with a line, and intersect each other at right angles. The houses are in general built of stone, and white washed, and the greatest numbers are two stories high, with flat roofs, and a kind of pediment in the centre. The spacious squares give the town an open and airy appearance; the public market is held in one; another is the common resort of the farmers and graziers with their waggons; and a third is used as a parade for exercising the troops. This last lies between the town and the castle, and has two of its sides completely built up with large and handsome houses. The castle stands a little east of the town. It is a pentagon fort, surrounded with a ditch and regular outworks, and contains within its walls the Lombard Bank, the Orphan Chamber, and most of the public offices of government. It also affords accommodation for 1000 men with their officers, and has magazines for artillery stores and ammunition. But though it commands the town and part of the anchorage, it is entirely indefensible against the batteries which have been erected upon the rising ground towards the Devil's Hill. The barracks, originally intended for an hospital, granaries, &c. which, with its two wings, occupies a part of one of the sides of the great square, is a large and regular edifice, and has sufficient convenience in the upper part of the building for 4000 men. The other public buildings are the Calvinist church, the Lutheran church, the court of justice, the guard-house, and the theatre.

Behind the town, on the acclivity of Table Mountain, is the government house, and a beautiful public garden, which is an oblong piece of ground, containing about 40 acres of rich land, and divided into forty-four squares by oak hedges. Part of it has been appropriated for the reception of scarce and curious native plants, and for experiments upon such Asiatic and European productions as may seem most likely to be cultivated with benefit to the colony. Over the same acclivity are also scattered a number of handsome villas, each of which is surrounded with plantations and gardens. Besides the castle, Cape Town is defended by several other forts, which have been erected along the shore of Table Bay. On the east side of the town is Fort Knokke, which is connected with the castle by a rampart called the *sea-lines;* and a little farther on is Craig's tower and battery. On the west side, and surrounding the Lion's Rump, are Rogge-bay battery, Amsterdam battery, and Chavonne battery, which all bear upon the anchorage; and the entrance of the bay is commanded by a small battery, called the Mouillé.

This town contains 1145 dwelling-houses, which are inhabited by 5500 whites and people of colour, and about 10,000 blacks. The greatest portion of the day is devoted to drinking and smoking by many. They have no relish for public amusements, and no taste for literature and the fine arts. Indeed, there is not a bookseller's shop in the whole town: and the only library of the place was left by an individual for the use of the public. It is under the direction of the church, but it is very little used. A public school even has never yet been established in the colony, though the exertions both of the government and the clergy have been united in the attempt. Many of the inhabitants are in easy circumstances, although there are not many who can be called rich, a circumstance which results in a considerable degree from the republican law of the province, by which property inherited is equally divided amongst children, male and female, without regard to sex or primogeniture. From the operation of this law, much family feud and dissensions have often arisen, from the children becoming rivals and competitors for the effects of a parent at a public sale.

Such luxuries as are imported from Europe or India are costly; but the necessaries of life may be procured at a moderate price. While a labouring slave earns from 2s. to 2s. 6d. a-day, and a mechanic or artificer from 5s. to 6s. a-day, the pound of butcher's meat is seldom above 2d.; even in the year 1800, when the demand was increased by the addition of 5000 troops and 300 seamen, the supply for the garrison was never higher than at the rate of $2\frac{5}{8}$ pounds for 6d. A pound of wholesome bread sells for 1d.; a pint of good wine for 3d.; and all kinds of fruits and vegetables are abundant and cheap.

The inhabitants of this town have a remarkable propensity for public sales, and many of them live entirely by such traffic, exposing to sale in the evening what they probably bought at the same place in the morning. All property, however, sold by public auction, is liable to a duty of 5 per cent.; and such was the rage for vendues, that during four successive months of 1801, the value of property sold in this way amounted to 1,500,000 rix dollars; "a sum," says Mr Barrow, "equal to the whole quantity of paper money in circulation; which, indeed, may be considered as the only money of late years that has circulated in the country."

The slaves used in this colony are imported from the west coast of Africa, from Mozambique, the Malay Islands, or they are the offspring of slaves born in the country. The African negroes are the best adapted to field labour; the Malays are esteemed the most acute in point of intellect, and the most docile; the artizans, therefore, are generally taken from this class; but they are capricious and vindictive; they set so little value upon their own lives, that they do not hesitate to commit the most atrocious and unprovoked murders, to gratify their revenge for injuries received or supposed. Their dispositions were so well known to the Dutch government, that the colonists were prohibited from having Malay slaves; but many evaded the law, and forfeited their lives for their temerity.

It has been observed, that slaves at the Cape of Good Hope are well treated by their masters, a position which we are the less disposed to controvert, because we suppose it to have been founded on comparison of the condition of the most unfortunate of our fellow creatures in this and other countries, where the horrors of the slave trade exist; but since it is self-evident, that the comfort and happiness of the slave must necessarily depend upon the temper, habits, and character of his master, we need not cite examples to demonstrate, that cruelty is the necessary and inseparable concomitant of slavery, even in its mildest form. For the commerce and government of Cape Town, we must refer to the preceding article, and the authorities thereto subjoined. S. Lat. 33° 55′ 42″, E. Long. 18° 23′ 15″.[*] (*p*)

CAPELLA, a star of the first magnitude, in the left shoulder of Auriga. See ASTRONOMY.

CAPIAS, in the law of England, is a writ or process, of which there are several kinds.

Capias ad respondendum, is a writ sued out before judgment, where an *original* is taken out, &c. to take the defendant, who had neglected to appear in the previous process, and make him answer the plaintiff. If, therefore, the defendant, being summoned, makes default, or if the sheriff returns a *nihil*, or that the defendant hath nothing whereby he may be summoned, attached, or distrained, the *capias* usually issues, commanding the sheriff to take the body of the defendant, and keep him, so as he may present him in court on the day of the return. This writ, and all others subsequent to the original,—not issuing out of chancery, but from the court into which the original was returnable, grounded on what has passed in that court, in consequence of the sheriff's return, issuing under the private seal of that court, and not under the great seal of England; and *teste'd*,—not in the king's name, but in that of the chief justice only, are called *judicial*, not *original*, writs. And these several writs must respectively bear date, the same day on which the writ immediately preceding was returnable. But it is now the usual practice to sue out the *capias*, in the first instance, upon a supposed return of the sheriff; and, afterwards, a fictitious original is drawn up, and a proper return thereupon, in order to give the proceedings a colour of regularity.

If the sheriff of the county, in which the injury is supposed to be committed, and the action is laid, cannot find the defendant in his jurisdiction, he returns *non est inventus*; upon which another writ issues, called a *testatum capias*, directed to the sheriff of the county where the defendant is supposed to reside. But in this case, also, it is usual to make out a *testatum capias* at the first, on the supposition that not only an *original*, but a previous *capias* had been granted, although in reality they never were. When a defendant absconds, however, and the plaintiff would proceed to an outlawry against him, an original writ must be sued out regularly, and after that a *capias*. And if the sheriff returns a *non est inventus* upon the first *capias*, then there issues an *alias*, and after that a *pluries* writ; and if a *non est inventus* be returned upon all of these, then a writ of *exigent* may be sued out in order to outlawry.

Such is the first process in the Court of Common Pleas. In the King's Bench, also, they may, and frequently do, proceed by *original* writ, with *attachment* and *capias*, particularly in actions of ejectment and trespass. The writ, however, is returnable, not at Westminster, where the Common Pleas are fixed by *Magna Charta*, but *ubicunque fuerimus in Anglia*; the King's Bench being removeable into any part of England, at the pleasure of the crown. Blackst. *Comment.* B. iii. ch. 19. Jacob's *Law Dict.*

Capias ad satisfaciendum, is a writ of execution, after judgment, the intent of which is to imprison the body of the defendant, until he makes satisfaction to the plaintiff for the debt, costs, and damages, in a process. This writ, therefore, does not lie against privileged persons, peers, members of parliament, executors or administrators, nor against such other persons as could not be originally held to bail.

Capias utlagatum, is a writ which lies to arrest a person who appears publicly after outlawry, who may be committed until the outlawry be reversed.

Capias pro fine, is a writ which issues for taking the body of one who is fined to the king for some offence, and does not discharge the fine according to the judgment. By the statute 5 and 6, W. & M. c. 12. *capiatur fines* are taken away in several cases.

Capias in withernam, is a writ which lies for recovering goods or cattle taken in distress, when the sheriff's inquest determines against the distreinor. If the distress be taken out of the county, or concealed, so that the sheriff cannot make deliverance in *replevin*, then there issues to him a *capias in withernam*, or *in vetito namio*, a term which signifies a reciprocal distress, to take as many goods or cattle of the distreinor, by way of reprisals.

Capias ad audiendum judicium, is a writ which issues against one who has been found guilty of a misdemeanor, to bring him in to receive his judgment; and if he absconds, he may be prosecuted, even to outlawry. Blackst. *Comment.* B. iv. ch. 29. (*z*)

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[*] Such of our readers as are acquainted with the different works which contain an account of the Cape of Good Hope, will readily perceive that we have had access to much valuable and original information which has never been published, and that we have thus been enabled to correct many errors which the latest writers have committed. For these important communications, the Editor has been indebted to WILLIAM SOMERVILLE, Esq. Inspector of Military Hospitals, who spent many years at the Cape, and who was peculiarly fitted, both by his situation and talents, to obtain the most correct information respecting that important colony. We trust that in many other parts of our work we shall have occasion to acknowledge assistance from the same quarter: and in the mean time we look forward with much impatience to the publication of that gentleman's Travels into the interior of Africa, which we hope he will soon be induced to give to the world. ED.

CAPILLARY ATTRACTION.

Capillary Attraction, from *capillus*, "a hair," is properly that force by which water, or any other fluid, is raised above its level in glass tubes, whose diameter does not exceed that of a hair. It is now employed in a more general sense, to denote that force with which solids act upon fluids, either in raising them above, or depressing them below, their natural level, when the solid is simply immersed in the fluid, or when the fluid is included in a tube, or between two plates formed from the solid. In attempting to give as complete a view of this interesting portion of physics as the limits of our work will permit, we shall direct our readers attention to the different phenomena of capillary attraction, as they have been ascertained by direct experiment, and to the different theories by which these phenomena have been explained.

Phenomena of Capillary Attraction.

Exp. 1. If water, or any other fluid, excepting mercury and the metals in a fluid state, be poured into a clean vessel, the fluid in contact with the sides of the vessel will be raised above the level of the fluid in the middle of the vessel, and the fluid surface will be terminated by an elevated ring of fluid. See Plate CX. Fig. 1, where A B are the sides of the vessel, and *c*, *d*, the elevated fluid.

Exp. 2. If a solid body is immersed in a fluid, the fluid will be raised round the sides of the solid, as in Fig. 2, where S is the solid, and *c d* the elevated fluids.

These phenomena may be seen most distinctly, by viewing the image of a rectilineal object, seen by reflection from the fluid surface. The rectilineal image will indicate, by its change of form, the magnitude and extent of the elevated ring.

Exp. 3. If the fluid, used in experiments 1 and 2, is mercury, or any metal in a state of fusion, the fluid in contact with the sides of the vessel in *Exp.* 1, or with the sides of the solid body in *Exp.* 2, will be depressed below the general level, as is exhibited in Figures 3d and 4th.

Exp. 4. If a glass tube A, whose internal diameter or bore is less than the 10th of an inch, be immersed at one end into a fluid in the vessel MN, the fluid will rise to A to a considerable height above the fluid surface. If another capillary tube B of a greater bore is immersed in the same fluid, the fluid will also rise in the tube above its level, but not to such a height as in the tube A. By comparing the heights of the fluid in the two tubes, with the diameters of their bores, it is found that the heights are inversely as the diameters. That is, if D be the diameter of the larger tube DB, *d* the diameter of the smaller tube CA, A the altitude of the fluid in the former, and *a* its altitude in the latter, we shall have $A:a=d:D$, and consequently $AD=ad$. Hence it follows, that the product formed by multiplying the diameter of any capillary tube, by the altitude to which any fluid rises in the tube, is a constant quantity.

The following are the heights to which water has been observed to rise in capillary tubes, reduced to a tube whose diameter is $\frac{1}{100}$th of an inch:

Height of the water.	Constant quantity, A × D	Observers.
Inches.		
2.1	0.021	Hauy and Tremery.*
2.6	0.026	Hallstrom.
3.27	0.032	Dr Brewster.
3.92	0.0392	Muschenbroek.
4.0	0.040	Average assumed by Dr Young.
4.2	0.042	Monge.
4.28	0.0428	Weitbrecht.
4.6	0.046	Deduced from Morveau's experiments.
4.8	0.048	Martin.
5.3	0.053	Atwood.

The great discrepancy between these results, which amounts to more than a half of the whole altitude, is a most satisfactory proof of the total insufficiency of the method of measurement which was employed.

Exp. 5. If the preceding experiment is tried with fluids of different kinds, it will be found that they rise to different altitudes. Messrs Hauy and Tremery found, that oil of oranges rose 6.74 thousandths of a metre, in a tube whose diameter was one thousandth of a metre, which reduced to a tube $\frac{1}{100}$ of an inch in diameter, gives only 1.0447 inch, or 0.010447 for the constant quantity. Mr Benjamin Martin made a variety of experiments on different fluids, with a tube $\frac{1}{25}$ of an inch in diameter, and obtained the following results.

	Altitude of the Fluids.	Constant Product
Common spring Water	1.2	.048
Spirit of Wine	1.1	.044
Tincture of Galls	1.1	.044
Recent Urine	1.1	.044
Vinegar	0.95	.038
Spirit of Salt	0.9	.036
Ol. Tart. per deliq.	0.9	.036
Small Beer	0.9	.036
Strong Spirit of Nitre	0.85	.034
Spirit of Hartshorn	0.85	.034
Cream	0.8	0.32
Skimmed Milk	0.8	.032
Aquafortis	0.75	.030
Red Wine	0.75	.036
White Wine	0.75	.036
Ale	0.75	.030
Ol. Sul. per Campan.	0.65	.026
Sulphuric Acid	0.65	.026
Sweet Oil	0.6	.024
Oil of Turpentine	0.55	.022

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* These gentlemen found, that in a tube whose diameter was one thousandth part of a metre, water rose to the height of 13.57 thousandths, hence the product of the diameter and height will be $.039371 \times 13{,}57 \times .039371 = 0.1054$.

	Altitude of the Fluids.	Constant Product.
Geneva	0.55	.022
Rum	0.5	.020
Brandy	0.5	.020
White hard Varnish	0.5	.020
Spirit of Wine	0.45	.018
Tincture of Mars	0,45	.018

Exp. 6. If tubes of different lengths are employed, the fluid will never ascend to the top of the tube, however short. Thus in Plate CX. Fig. 5. if the tube AC is broken off at P, the fluid will stand at *p* below the top P, though it formerly rose as high as A. We have tried this experiment repeatedly with a tube 0.36 of an inch long, and 0.043 in diameter, and have found that the fluid *always* rises to the very top of the tube.

Exp. 7. If a capillary tube, composed of two cylinders of different bores, be immersed in a fluid first with the widest part downwards, as at E, Fig. 5. and afterwards with the narrowest part downwards, as at F, Fig. 5. the fluid will ascend in both cases to the same height.

Exp. 8. When the widest part of the tube is not capillary, but is of such a magnitude that the fluid will not rise spontaneously to the smaller part, let the wider part be filled by suction, and the fluid will stand at the same height in the smaller part of the tube, as it would have done had the whole tube been of the same bore with the capillary part.

Exp. 9. If the tube, when filled by suction, as in the preceding experiment, is placed in the receiver of an air pump, and the air exhausted, the fluid in the wider part of the tube will not remain suspended in the tube as formerly, but will fall down into the vessel.

Exp. 10. If one tube is placed within another so that their axes coincide, the water will rise in the space between the tubes only to half the height that it would have done in a single tube, in which the diameter of the bore is equal to the interval between the two tubes.

Exp. 11. When the internal diameter of several capillary tubes are equal, the fluid will rise to the same height whether the tubes are thin or thick.

Exp. 12. Having plunged a capillary tube into water, let the lower extremity of it be closed with the finger, and when the tube is taken out of the water, let its external surface be gently wiped. Upon withdrawing the finger, the water is seen to subside in the tube and form a drop at its lower base; but the height of the column is always greater than the elevation of the water in the tube, in the common experiment of plunging it in water. It has also been observed, that the increase in the elevation of the water is more considerable, the smaller the diameter of the drop beneath.

Exp. 13. If a drop of water is introduced into a conical capillary tube, open at both ends, and held in a horizontal position, it will move towards the vertex of the cone.

Exp. 14. When water is forced through a capillary tube, of such a bore that it is discharged only in successive drops, it will flow in a constant and accelerated stream when the tube is electrified, and the acceleration will be inversely proportional to the diameter of the bore. This fact seems to be denied by Carmoy. See *Journ. de Physique*, xlv. 106.

Exp. 15. A capillary syphon, which discharges cold water only by drops, will discharge water of a higher temperature in a continued stream.

Exp. 16. Let a capillary tube be held in a position inclined to the horizon, and let a drop of liquid be let fall upon its surface, then bringing the tube into a vertical position at the instant when the drop has arrived at the inferior orifice, the fluid will run through the orifice, and rise in the interior of the tube.

Exp. 17. If the preceding experiments with capillary tubes, excepting *Exp.* 9, be made in the exhausted receiver of an air pump, the fluids will rise to the same height as in the open air.

Exp. 18. If the bore of a capillary tube be lined with a very thin coating of grease, or any unctuous substance, the water will not ascend in the tube.

Exp. 19. By observing carefully the upper surface of the column of fluid, elevated in capillary tubes, it will be found to be concave upwards. M. Hauy found, that in capillary tubes of glass, of very small diameters, the concave surfaces of water and of oils differ very little from the form of a hemisphere.

Exp. 20. If the capillary tube is taken out of the fluid in which it is immersed, and inclined to the horizon so that the included fluid may obey the action of gravity, the concavity will appear at both ends of the column, and suffers no variation either in its shape or size, whether the tube be held in a vertical, a horizontal, or an oblique direction.

Exp. 21. When the column of water is thus made to move along the tube, it seems to suffer a resistance as it approaches to either end, and it does not completely reach the extremity of the tube till the tube is almost inverted.

Exp. 22. When a capillary tube is immersed in mercury, or in any metal in a state of fusion, the fluid, instead of rising, is depressed in the tube below the general level. See Plate CX. Fig. 4. Gellert found that when a glass tube was immersed in melted lead, the depression multiplied by the bore was 0.054. Messrs Hauy and Tremery found, that the depression of mercury in a capillary tube one thousandth part of a metre in diameter, or 0.039371 of an English inch, was 0.2887 of an English inch, the product being .01137. The ultimate product inferred from Lord Charles Cavendish's experiments is .015.

Exp. 23. If a drop of mercury be introduced into a conical capillary tube, held in a horizontal position, the mercury will move towards the wide end.

Exp. 24. By observing the surface of a column of mercury depressed in a capillary tube, or inclosed in a barometer tube, it will be found to be convex upwards. Mr Hauy has endeavoured to show, that this convexity differs very little from the form of a hemisphere. Dr T. Young maintains that this result is inaccurate, and that the angle formed by the surface of the mercury with the side of the tube is 140°. He obtained this result, by observing in what position the light reflected from the mercurial surface began to reach the eye, and he has found it correct, from the comparison of a great variety of experiments of different kinds. This ingenious philosopher has prosecuted this branch of capillary attraction with great ability and success. He has calculated the precise form of the surface of the mercury in a variety of cases. In order to confirm these calculations, he employed another method, which consists in finding the mass of the quantity of fluid, supported by the tension of the surface at each concentric circle, and inferring from this the inclination of the curve to the horizon, assuming for the mean height the height of the external circumference of each portion; a supposition which almost compensates for the omission of the curvature of its surface. As a specimen of these methods, we shall insert the following Tables, by means of which the curves may be correctly delineated. They are suited to a central depression of 0.007.

First Method by the Curvature.

Arc.	Horizontal ordinate.	Depression.	Arc.	Horizontal ordinate.	Depression.
0	.00000	.00700	12	.16177	.01986
1	.02444	.00721	14	.17338	.02254
2	.04758	.00782	16	.18344	.02524
3	.06651	.00865	18	.19229	.02793
4	.08338	.00968	20	.20012	.03063
5	.09791	.01082	25	.21603	.03722
6	.11049	.01203	30	.22869	.04381
7	.12153	.01329	35	.23895	.05033
8	.13146	.01458	40	.24731	.05676
9	.14022	.01589	45	.25420	.06307
10	.14814	.01721	50	.25986	.06911

Second Method by the Tension.

Arc.	Horizontal ordinate.	Depression.	Arc.	Horizontal ordinate.	Depression.
.00	.00000	.00700	.16	.15948	.01909
.02	.02000	.00714	.18	.17908	.02353
.04	.04000	.00757	.20	.19842	.02921
.06	.05999	.00830	.22	.21732	.03653
.08	.07977	.00939	.24	.23550	.04530
.10	.09993	.01101	.26	.25039	.05707
.12	.11985	.01302	.2705	.25740	.06460
.14	.13971	.01566			

Dr Young has embodied the results of these calculations in the following formula, which gives the central depression without any perceptible error, $c=\frac{0.015d}{dd+0.16}$, which is nearly half the versed sine of a spherical surface, and then $f=\frac{0.015}{d}-\frac{3}{4}e-14.5e^3$. This approximate formula supposes the surface to be spherical, and is corrected by a comparison with the results of the calculations, so as to agree with them all without an error of one two-thousandth of an inch in the most unfavourable cases. Dr Young has also found a formula, when the diameter of the tube is moderate, for shewing the difference between the central and marginal depression, which may be of the greatest service in correcting the height of the barometer, whether we have obtained a measure of the highest or lowest point of the surface

$$g=\frac{5d+100d^3}{15(5d+100d^3)+18}$$

If d were very large, it would require some farther correction, g being ultimately too great by 0.0069. As our limits will not permit us to pursue this interesting subject any farther, we must refer our readers to Dr Young's able paper on the Cohesion of Fluids, published in the *Phil. Trans.* for 1805, and in his *Lectures on Nat. Phil.* vol. ii. p. 666—669.

Exp. 25. When the mercury and the capillary tube are perfectly dry, the fluid will rise above the general level, like all other liquids. This was ascertained by Professor Casbois of Metz, who boiled the mercury several times, in order to free it from all humidity, and expel any foreign particles. By drying the mercury and the tube to a very great degree, Messrs La Place and Lavoisier constructed barometers, in which the mercurial column was terminated above by a plane surface, and they even succeeded in rendering the upper surface of the mercury concave. The observations given under Experiment 24 are referable to barometers constructed in the usual way.

Exp. 26. If two plates of glass be placed parallel to each other, at the distance of about $\frac{1}{100}$ of an inch, the water in which they are immersed will rise one inch above its level in the vessel; and when the plates are placed at different distances, the heights to which the water will rise, will be reciprocally proportional to the distances of the plates.

Exp. 27. If a capillary tube be taken of such a magnitude, that the diameter of its bore is equal to the distance between the plates in the preceding experiment, the water will rise in it to the same height as between the plates. See Newton's *Optics*, p. 366.

Exp. 28. If a fluid is either elevated or depressed between two vertical and parallel planes, the planes will tend to approach each other.

Exp. 29. "If two plane polished plates of glass, three or four inches broad, and twenty or twenty-five long, be laid one of them parallel to the horizon, the other upon the first, so as at one of their ends to touch one another, and contain an angle of about 10 or 15 minutes, and the same be first moistened on their inward sides with a clean cloth dipped into oil of oranges, or spirit of turpentine, and a drop or two of the oil or spirit be let fall upon the lower glass at the other end; so soon as the upper glass is laid down upon the lower, so as to touch it at one end as above, and to touch the drop at the other end, making with the lower glass an angle of about 10 or 15 minutes: the drop will begin to move towards the concourse of the glasses, and will continue to move with an accelerated motion till it arrives at that concourse of the glasses. For the two glasses attract the drop, and make it run that way towards which the attractions incline. And if, when the drop is in motion, you lift up that end of the glasses where they meet, and towards which the drop moves, the drop will ascend between the glasses, and therefore is attracted. And as you lift up the glasses more and more, the drop will ascend slower and slower, and at length rest, being then carried downwards by its weight as much as upwards by the attraction. And by this means you may know the force by which the drop is attracted at all distances from the concourse of the glasses. Now, by some experiments of this kind, (made by Mr Hauksbee,) it has been found that the attraction is almost reciprocally in a duplicate proportion of the distance of the middle of the drop from the concourse of the glasses, viz. reciprocally in a simple proportion, by reason of the spreading of the drop, and its touching each glass in a larger surface; and again reciprocally in a simple proportion, by reason of the attraction growing stronger within the same quantity of attracting surface. The attraction therefore within the same quantity of attracting surface is reciprocally as the distance between the glasses. And therefore, where the distance is exceeding small, the attraction must be exceeding great." Newtons's *Optics*, p. 367.

Exp. 30. If the plates in *Exp.* 26. are inclined to each other at a small angle, and are immersed in water with the line of their intersection vertical, the water will ascend between them, and will form a beautiful curve. This experiment is represented in Plate CX. Fig. 6. By measuring the ordinates and abscissæ of the curve *a b*, Mr Hauksbee found it to be the common Apollonian hyperbola. This indeed follows from *Exp.* 26, from which it appears that the altitudes are reciprocally as the distances of the plates. The heights of the fluid being the ordinates of the curve, and the distances of the plates being as the abscissæ, the ordinates are inversely proportional to their respective abscissæ, which is the property of the common hyperbola.

The preceding experiments, though numerous and varied, are obviously insufficient to form a proper basis for a philosophical theory. The enormous discrepancy among some of the results, as obtained by different philosophers, is completely bewildering; and, if we did not know that they were all made in the eighteenth century, we should have imagined that they were obtained in the dullest age of experimental philosophy. The height to which water ascends in a capillary tube, the diameter of whose bore is $\frac{1}{100}$ of an inch, has been stated in the latest elementary works upon natural philosophy, at 5 inches and 3-tenths, according to the experiments of Mr Atwood; while, according to the more recent experiments of Messrs Hauy and Tremery, made at the desire and under the eye of La Place, the water rises only to the height of 2 inches and 1-tenth. The difference between these quantities amounts nearly to *two-thirds* of the whole; and what is still more perplexing, we are unacquainted with the particular manner in which the experiments were made, so that we are unable to discover any ground of preference, from the various precautions which were probably taken by the different observers to ensure accuracy, and to avoid error.

Under these circumstances, the writer of this article resolved to repeat the experiments himself; and he was particularly anxious to bring his apparatus into such a state, that he could always obtain the same result by repeated trials. After much trouble, he succeeded in this attempt to such a degree, that the water uniformly stood at the same height in the tube; and the same degree of accuracy was obtained for the other fluids, which were submitted to examination. To enable the reader to form a proper estimate of the degree of confidence which these results should inspire, we shall describe the precautions which were found necessary in the course of the experiments.

Having obtained a glass tube 7.9 inches long, and of a uniform circular bore, we took a wire of a less diameter than the bore of the tube, and formed a small hook at one of its ends. This hook was fastened to the middle of a worsted thread, of such a size, as when doubled, to fill the bore of the tube. The wire was then passed through the tube, and the worsted thread drawn after it; and when the whole was plunged in an alkaline solution, the worsted thread was fixed at one end, and the tube was drawn backwards and forwards, till it was completely deprived, by its friction on the thread, of any grease or foreign matter which might have adhered to it. The tube and thread were then taken to clean water, and the same operation was repeated.

When the tube was thus perfectly cleaned, it was fixed vertically, by means of a level, Plate CX. Fig. 7. in the axis of a piece of wood D, supported by the arm A D, fixed upon a stand A B; and it was also furnished with an index *m n*, which was moveable to and from the extremity *b*. On the arm C E, moveable in a vertical direction by the nut C, was placed a glass vessel F, containing the fluid, and nearly filled with it. The nut C, was then turned till the extremity *b* of the tube touched the surface of the fluid, which was indicated by the sudden rise of the liquor round its sides. The fluid then rose in the tube till it remained stationary, and the index *m n* was moved till its extremity *n* pointed out the exact position of the upper surface of the fluid. In this situation, the distance *n b* was a measure of the ascent of the liquid above its level in the vessel E. In order to ascertain, however, whether the fluid was stationary in consequence of any obstruction in the tube, or of an equilibrium of the attracting forces, the vessel with the fluid was raised a little higher than its former position, by means of the nut C, and then depressed below it. If the fluid now rose to *o*, a little above *n*, and afterwards sunk to *p*, a little below it, so as always to rise and fall with facility and uniformity along with the surface of the fluid in the vessel, it was obvious that it suffered no obstruction in the tube, and that *n b* was the accurate measure of its height. By separating the extremity *b* of the tube from the surface of the fluid, the fluid always rises above *n*; but upon again bringing them into contact, the fluid resumes its position at *n*. If there should be any portion of fluid at the end *b* of the tube, when it is again brought in contact with the fluid surface, the water would rise around it before it had reached the general level, and therefore the height of the fluid, obtained by measuring from the end of the tube, would be too small. In order to avoid this source of error, the index should have a projecting arm *m r*, Plate CX. Fig, 7. No. 2. carrying a screw *st*, whose sharp point *t* can be easily brought on a level with the end *b* of the tube. When the extremity *t*, therefore, which can always be kept dry, comes in contact with the fluid surface P Q, the extremity *b* must also be exactly in the same level, even though the fluid had already risen around it. The tube was then cleaned, as formerly, for a subsequent observation. The results which were thus obtained for a great variety of fluids, and with a tube 0.0561 of an inch in diameter, are given in the following Table.

		Altitude of the fluid. Inches.	Constant product, A × D
	Water	0.587	0.0327.
	Very hot Water	0.537	0.0301
	Muriatic acid	0.442	0.0248
	Oil of boxwood	0,427	0.0240
5.	Oil of cassia	0.420	0.0236
	Nitrous acid	0.413	0.9232
	Oil of rapeseed	0.404	0.0227
	Castor oil	0.404	0.0226
	Nitric acid	0.395	0.0222
10	Oil of spermaceti	0.392	0.0220
	Oil of almonds	0.387	0.0217
	Oil of olives	0,387	0.0215
	Balsam of Peru	0.377	0.0212
	Muriate of antimony	0.373	0.0209
15	Oil of Rhodium	0.366	0.0305
	Oil of Pimento	0.361	0.0203

		Altitude of the fluid. Inches.	Constant product, A × D
	Cajeput oil	0.357	0.0200
	Balsam of Capivi	0.357	0.0200
	Oil of penny royal	0.355	0.0199
20	Oil of thyme	0.354	0.0199
	Oil of brick, distilled from spermaceti oil	0.354	0.0199
	Oil of caraway seeds	0.353	0.0198
	Oil of rhue	0.353	0.0198
	Oil of spearmint	0.351	0.0197
25	Balsam of sulphur	0.349	0.0196
	Oil of sweet fennel seeds	0.347	0,0195
	Oil of hyssop	0.347	0.0195
	Oil of rosemary	0.344	0.0193
	Oil of bergamot	0.343	0.0192
30	Oil of amber	0,343	0.0192
	Oil of anise seeds	0.342	0.0192
	Oil of Barbadoes tar	0.341	0.0191
	Laudanum	0.340	0.0191
	Oil of cloves	0.334	0.0187
35	Oil of turpentine	0.333	0.0187
	Oil of lemon	0.333	0.0187
	Oil of lavender	0.328	0.0184
	Oil of camomyle	0.327	0.0184
	Oil of peppermint	0.327	0.0184
40	Oil of sassafras	0.327	0.0184
	Highland whisky	0.327	0.0184
	Brandy	0.326	0.0183
	Oil of wormwood	0.326	0.0183
	Oil of dill seed	0.324	0.0182
45	Oil of ambergrease	0.323	0.0181
	Genuine oil of juniper	0.321	0.0180
	Oil of nutmeg	0.320	0.0180
	Alcohol*	0.317	0.0178
	Oil of Savine	0.310	0.0174
50	Æther	0.285	0.0160
	Oil of wine	0.273	0.0153
	Sulphuric acid	0.200	0.0112

The method of measuring capillary attraction, by ascertaining the altitudes to which different fluids will rise in a glass tube, is not only liable to numerous objections, and to much uncertainty in the results, but is applicable only to the single substance of glass. We are thus left completely in the dark respecting the action which all the other solids exert upon fluid substances.

In order to remedy this defect, an instrument of very general application was some time ago proposed by Dr Brewster, the object of which was to measure, upon an optical principle, the diameter of the elevated circle of fluid, which any solid raises above the general level. Thus, in Plate CX. Fig. 8. let MNOP be the plan of a vessel filled with any fluid, A the section of a solid cylinder of any substance immersed in the fluid and at right angles to its surface, and BC the diameter of the circle of fluid, which is elevated by the action of the solid A. This elevated fluid is not terminated abruptly by the circle BC, but there is obviously a certain distance from A, where the ordinate of the curve becomes a perceptible quantity, either when examined by the eye or by a microscope. The apparent boundary of the circle at B is determined by observing the image of two delicate parallel fibres fixed in a frame at D, as seen by reflection from the surface of the fluid at B, to an eye at F, assisted by a powerful microscope, adjusted to a distance equal to EB + BD. When this image is seen by reflection from any part of the fluid surface without the circle BC, it will suffer no change of form; but when it is seen by reflection from any portion of the elevated fluid, the fibres will appear distorted, and they will therefore indicate, by their return to a rectilineal form, the apparent termination of the circle BD. The same observation is made at D, on the other side of A; and a measure is thus obtained of the circle BC, by means of the micrometer screw, by which the microscope at E, and the frame at D, are moved along the sides of the vessel. By this instrument, which has been constructed and tried with success, we can employ solids of all kinds, and ascertain their action upon fluids, under circumstances which could not be obtained with capillary tubes. This method has another great advantage, as it is extremely easy to remove from the outsides of the solids all that grease and foreign matter which it is so difficult to remove in tubes of glass. In another part of our work, we hope to be able to give a complete drawing of this instrument, and a table of results for various bodies. See Dr Brewster's *Treatise on New Philosophical Intsruments, for various purposes in the Arts and Sciences*, Book vi. Edin. 1812.

Theory of Capillary Attraction.

Dr Hooke, who was one of the earliest writers on capillary attraction, ascribed the ascent of fluids, in capillary tubes, to the unequal pressure of the atmosphere, arising from a diminution of the pressure of the air in consequence of its friction in the tube. This opinion was maintained till the experiment was tried in the receiver of an air-pump, and when the fluid was found to rise as high in vacuo as in the open air, a new cause was sought for the phenomenon. Sir Isaac Newton and Mr Hauksbee were of opinion, that the attraction of the tube was insensible at sensible distances. Dr Jurin ascribed the suspension of the fluid to the attraction of the ring of glass to which the upper surface of the water is contiguous, and adheres. Dr Hamilton and Dr Matthew Young maintained that the fluid was elevated by the lower ring of glass contiguous to the bottom of the tube, and that this ring raises the portions of fluid immediately below it, and then the other portions in succession, till the column thus elevated was in equilibrium with the attraction of the ring.

Clairaut had the honour of being the first mathematician who gave any thing like a theory of capillary attraction. After pointing out the insufficiency of preceding theories, he enters into an analysis of all the forces by which the fluid is suspended in the tube, of which we shall endeavour to give our readers a brief account. Let ABCDEFGH (Plate CX. Fig. 9.) be the section of a capillary tube, MNP the surface of the water in the vessel, I *i* the height of its ascent, VIZ the concave surface of the fluid column, and IKLM an indefinitely small column of fluid reaching to the surface at M. Now the column ML is solicited by the force of gravity which acts through the whole extent of the column, and by the reciprocal attraction of the moleculæ, which, though they act the same in all the points of the column, only exhibit their effects towards the extremity M. If any particle *e* is taken at a less distance from the surface than the distance at which the attraction of the liquid generally terminates, and if *m n* is a plane parallel to MN, and at the same distance from the particle *e*, then this particle will be equally attracted by the water between the planes MN, *mn*. The water, however, below *mn*, will attract the particle downwards, and this effect will take place as far as the distance where the attraction ceases.

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* Dr Young found the height of ascent of water and diluted spirit of wine to be as 100 to 64.

The column IK, on the other hand, which is in a state of equilibrium with ML, is acted upon by the force of gravity through the whole extent of the column, also by other forces at the upper and lower extremities of the tube. The forces exerted at the upper part of the column, are the attraction of the tube upon the particles of water, and the reciprocal attraction of these particles; but as every particle is as much drawn upwards as downwards by the first of these forces, the consideration of it may be dropped. In order to estimate the other force, let a horizontal plane VX touch the concavity at I, a particle *p*, situated infinitely near to I, is attracted by all the particles above VX, and by all below it whose sphere of activity comprehends that particle; and as the particles above *p* are fewer than those below it, the result of these forces must be a force acting downwards.

In order to estimate the value of the forces which act at the lower end O of the tube, let us suppose that the tube has a prolongation to the bottom of the vessel, formed of matter of the same density as the water. Let a particle R be situated a little above the extremity of the tube, and another Q as much below that extremity, they will be equally acted upon by the water above that place, and by the water between the fictitious prolongation of the tube, and therefore these forces will destroy one another. By applying to the case of the particle R the same reasoning that was used for the particle *e*, it will appear, that the result of its attraction by the tube is an attraction upwards. The particle R is likewise attracted downwards by the supposed prolongation of the tube, and the difference between these is the real effect. The other particle Q is also drawn upwards by the tube with the same force as R, since, by the hypothesis, it is as far distant from the points D, G, as the particle R is from the points *d*, *g*, where, with respect to it, the real attraction of the tube commences. The particle Q is attracted also downwards, by the supposed prolongation of the tube, and the difference of these actions is the real effect. Hence the double of this force is the sum of all the forces that act at the lower part of the tube. These forces, when combined with those exerted at the top of the tube, and with the force of gravity, give the total expression, which should be combined with that of the forces with which the column ML is actuated.

Clairaut then observes, that there is an infinitude of possible laws of attraction, which will give a sensible quantity for the elevation of the fluid above the level MN when the diameter of the tube is very small, and a quantity next to nothing when the diameter is considerable; and he remarks, that we may select the law which gives the inverse ratio between the diameter of the tube and the height of the liquid, conformable to *Exp.* 4.

It follows from the expression obtained by Clairaut, that if any solid, AB, (Plate CX. Fig. 10.) possesses half the attracting power of the fluid CD, the surface of the fluid will remain horizontal; for the attraction being represented by DA, DE, and DC;—DA and DE may be combined into DB, and DB and DC into DE, which is vertical. The water will, therefore, not be raised, since the surface of a fluid at rest must be perpendicular to the resulting direction of all the forces which act upon it.

When the attracting power of the solid is more than half as great, the resultant of the forces will be GF in Fig. 11, and therefore the fluid must rise towards the solid, in order to be perpendicular to GF. When the attractive power of the solid is less than that of the fluid, the resultant will be HF in Fig. 11: and therefore, as in the case of mercury, the surface must be depressed, in order to be perpendicular to the force.

The subject of capillary attraction was next taken up by Segner in 1751, who referred all the phenomena to the attraction of the superficial particles of the fluids. He deduces this principle from the doctrine of attraction. He supposes the attraction of the tube to be insensible at sensible distances; and he has shewn that the curvature of each part of the surface of a fluid is proportional to its distance from the general level; and without much error, he has obtained from experiments the magnitude of this curvature at a given height, both for water and mercury.

M. Monge has followed Segner in ascribing the capillary phenomena to the cohesive attraction of the superficial particles of the fluids; and he maintains that the surfaces must be formed into curves of the nature of lintеariæ, resulting from the uniform tension of a surface resisting the pressure of a fluid, which is either uniform, or varies according to a given law.

In a very ingenious paper on the cohesion of fluids, which was read by Dr Young in the Royal Society in 1805, that able mathematician has given a new theory of capillary attraction. He has reduced all the phenomena of cohesion to the joint operation of a cohesive and a repulsive force, which balance each other in the internal parts of a fluid, where the particles are brought so near that the repulsion is exactly equal to the cohesive force by which they are attracted; and he assumes only, that the repulsion is more increased than the cohesion, by the mutual approach of the particles. By this means Dr Young has connected together a variety of facts which had hitherto been unexplained; and we regret that our limits will not permit us to give a more detailed account of his ingenious speculations.

More than a year after the publication of Dr Young's paper, M. La Place published a supplement to the *Mecanique Celeste*, upon capillary attraction, where he has proposed a theory, which has led him to several conclusions that Dr Young had already obtained by a more simple route. It is a very singular circumstance, that La Place should take no notice whatever of Dr Young's labours, as the volume of the Transactions which contained them, and several periodical works in which they were noticed, must naturally have found their way to Paris. La Place supposes, from *Exp.* 11. and 18. that capillary action, like the refractive force, and the chemical affinities, is only sensible at imperceptible distances; that a narrow ring of glass, immediately above the surface of the fluid, exerts its force on the water; and that this force, combined with the weight of the water, and the cohesion of its particles, produces the concave surface or meniscus of fluid with which the column is always terminated. He supposes this meniscus to be sustained by the action of the glass, while it exerts its own attraction on the fluid particles immediately below it, by means of which their gravity is diminished, and the water consequently rises in the tube; and he has determined the form of the meniscus to be that of a hemisphere, and its attraction to be equal to that of a spherule of water of the same diameter. Hence the attraction of the meniscus will be inversely as its diameter, or the diameter of the tube, that is, as the weight of the elevated column, and therefore the heights of ascent must be inversely as the diameter of the tube. "Since it has hitherto been usual with natural philosophers," says La Place, "to consider the concavity and convexity of the surfaces of fluids in capillary spaces, as a *secondary effect* of capillary attraction only, and not as the principal cause of phenomena of this kind, they have not attached much importance to the determination of the curvature of these surfaces. But the theory which has been here advanced, having shewn that all these phenomena depend principally on the curvature, it becomes of consequence to examine it." In opposition to the high authority of La Place, we agree with Professor Playfair in thinking, "that the principal and primary cause is that attraction, which sustains the meniscus, and enables it to act on the water below without being drawn out of its place. It is not the concavity of its surface that makes the water in the tube press less in the bottom than if its surface were plain; but it is the attraction of the glass that produces, in a manner equally direct, both the concavity and the diminution of pressure." The fact mentioned in *Exp.* 12, has been ascribed by La Place to the action of the drop upon the column, in consequence of its convexity; while Mr Playfair supposes the additional elevation to be occasioned by the action of the bottom and outside of the tube upon the drop, by which the column of water is lifted up to a higher level. We are disposed, however, to think, that the column of water, after being raised above its ordinary height in the tube, as in *Exp.* 12, is prevented from obeying the force of gravity by the force with which the drop below adheres to the bottom of the tube, and the force by which it resists any change of form; for the descent of the column to its usual height could only take place, either by detaching the drop altogether from the tube, or by giving it a more spherical, or a more elongated form. If the other explanations were true, then the column might be raised above its usual height in the tube, by placing a drop of water on the outside, and allowing it to descend to the bottom of the tube, where it would exert its force, according to La Place, or be acted upon by the tube, according to Mr Playfair, which is not the case. For further information on this subject, see Hooke's *Micographia*. Jurin, *Phil. Trans.* No. 355, and No. 363. Hamilton's *Lectures*, ii. p. 47. Hauksbee, *Phil. Trans.* 1706, p. 223; 1709, p. 258; 1711, p. 395; 1712, p. 413; 1712, p. 539; 1713, p. 151. Taylor, *Phil Trans.* 1712, p. 538; 1721, p. 209. Bullfinger, *Com. Petrop*, ii. 233; iii. 281. Muschenbroek *de tubis vitreis*, *Diss. Phys.* 271. Weitbrecht, *Com. Petrop.* viii. 261; ix. 275. Gellert, *Id.* xii. 293, 302. Segner, *Com. Gotting*, 1751, i. p. 301; La Lande *sur la cause de l'elevation des liqueurs*, 12 Paris, 177[illegible]. Morveau Rozier, *Journ.* i. 172, 460. Dutour, Rozier *Journ.* xi. 127; xiii. Sup. 357; xiv. 216; xv. 46, 234; xvi. 85; xix. 137, 287. Milan *Journ. Phys.* liv. 123; and *Repertory of Arts*, xvi. 427. Von Arnim in Gilbert's *Journal*, iv. 376. Hallstrom, *Id.* xiv. 425. Clairaut *Theorie de la Figure de la Terre tirées des principes de l'Hydrostatique.* § [illegible]. Dr T. Young on *The Cohesion of Fluids*, *Phil. Trans.* 1805, and in his *Nat. Phil.* ii. p. 649. La Place's *Mecanique Celeste.* Sup. au Dizieme Liv. Playfair's *Outlines of Nat. Phil.* vol. i. p. 17[illegible] 184. See also ADHESION and HYDRODYNAMICS. (β)

CAPITANATA. See NAPLES.

CAPITOL. See ROME.

CAPO D'ISTRIA, the *Ægida* and the *Justinopolis* of the ancients, is a sea-port town of Istria, situated upon an oval island, which is connected with the continent by means of a causeway half a mile long. This town is one of the largest places in that part of Istria which formerly belonged to the Venetians. It is about two miles in circumference; is the see of a bishop suffragan of the archbishop of Udina, and exclusive of the cathedral which was built in the 18th century; it has forty churches or chapels, and thirty convents; two hospitals, and a pawn-bank, where money is advanced on pledges. The principal articles of its commerce are derived from its salt-pits and vineyards. By means of an aqueduct which passes under the salt-works, the town is well provided with spring water. The air is here more salubrious than in the other maritime towns of Istria.

This town was taken by assault by the Venetians in the year 932, but it was retaken by the Genoese in the 14th century; and, in 1478, it was restored to the republic of St Mark. East Long. 13° 48′ 30″, North Lat. 45° 38′ 10″. See *Voyage Pittoresque et Historique de l'Istrie et de la Dalmatie, rédigé d'apres l'Itineraire de* L. F. Cassas, *peintre, par* Jean Lavallée. Paris, 1802. (*o*)

CAPPADOCIA was, in ancient times, a province of Lydia in Asia, extending from Mount Taurus to the Euxine Sea; but was divided first by the Persians, and afterwards by the Macedonians, into two dynasties. The northern division, which, from its situation, received the appellation of *Cappadocia ad Pontum*, was soon denominated Pontus, and under this title its history will more properly appear. The southern division, which we are now to describe, was at first called *Cappadocia ad Taurum*, or *Cappadocia Magna;* but when the other division took the name of Pontus, it claimed to itself the name of Cappadocia. This country, bounded on the east by the Euphrates and Armenia Minor; on the south by Lycaonia and Armenia Major; on the west by Galatia; and on the north by Pontus; stretches from the 38th to the 41st degree of north latitude. The name of this region, according to Pliny, was derived from the river Cappadox; according to Herodian, from Cappadocus, who is said to have been the founder of this dynasty, but whose existence is more than doubtful. Besides Mazaca, the metropolis of this kingdom, which was afterwards called Cæsaria by Tiberius, in honour of Augustus, Cappadocia could boast of the following cities; Comina, Diocæsaria, Neocæsaria, Tyana, Sebastia, and Sebastopolis. The principal rivers which fertilize this region, are the Melas, the Iris, now Casalmæ, and the Hylas. The district on the south-east, which lies around the Antitaurus, is mountainous and barren. The other parts are fertile, abounding with fruits of every kind; enriched with mines of silver, brass, iron, and alum; and producing alabaster, crystal, jasper, and onyx. The horses which were reared in this country were so excellent, that they were purchased by the surrounding nations, and became at last so famous at Rome, that none but the emperor was permitted to possess them.

From the feeble light of ancient history, we find that this country was a province of Lydia in the reign of Crœsus. When that kingdom yielded to the superior destiny of Persia, Cappadocia bowed to the conqueror, and the annual tribute of 1500 horses, 2000 mules, and 5000 sheep, stamped its subjection till the time of Cyrus. When that monarch was engaged in hunting, Pharnaces, one of his nobles, rescued him from a lion which was ready to devour him; and the crown of Cappadocia, and the hand of Atossa, the sister of Cyrus, marked his gratitude, and the valour of his deliverer. Pharnaces fell in a war with the Hyrcanians; and Smerdis, his son, cultivating the friendship of Persia, joined Darius against the Scythians, and took Marsagetes, the brother of their king, prisoner. Anaphas, who succeeded him, equalled his father in military renown, and in fidelity to the Persians. His name and kingdom descended to his son, who again was succeeded by Datames, the first of his race, who waged war with the Persians, and who atoned for his rashness on the field of battle, by the loss of his army and of his life. Ariaramnes his son, who succeeded him, suffered much from the superior power of Persia, yet, at the end of a reign of 50 years, he left his throne to his son Ariarathes I. This prince wisely courted the friendship of Artaxerxes Ochus, and with him waged war against the Egyptians, in which he acquired the most distinguished honours. Induced by affection to his brother Holophernes, he resigned to him a share of the government, and, at his death, that prince succeeded to the sovereign power, probably upon account of the youth of his brother's children; for at his death, he set aside his own family, and in return for his brother's kindness, restored the kingdom to his son Ariarathes II. This prince signalized his fidelity to the Persians, by setting at defiance the fame and the power of Alexander; but though the king of Macedon, by engaging in nobler conquests, was prevented from inflicting upon him signal vengeance, yet, at his death, Perdiccas conducted into Cappadocia a powerful army, and having routed the forces of Ariarathes, whom he took prisoner, and barbarously crucified, with all his nobles who fell into his hands, placed upon the throne his brother Eumenes, to whom that country had been assigned by the division of Alexander's dominions, which then took place. Ariarathes III. escaping from the slaughter of his father and brethren, wandered as an exile in Armenia till the death of Eumenes and Perdiccas, and the war between Antigonus and Seleucus occupied the whole attention of the Macedonians, and inspired him with the hope of recovering his paternal dominions. At the head of an army which he received from the friendship of Ardoates, king of Armenia, he entered Cappadocia, defeated Amyntas the Macedonian governor, and ascended the throne which his valour had purchased, and which his wisdom taught him to enjoy during a long and a happy reign. Ariaramnes II. his son, succeeded him; and cultivating the friendship of Antiochus Theos, king of Syria, obtained Stratonice, the daughter of that monarch, in marriage to his son, whom he associated with himself in the government, and advanced the prosperity of his country by a wise and peaceful administration. His son Ariarathes IV. inherited the dominions, but not the peaceful disposition of his father. Invading the territories of Arsaces, the founder of the Parthian dynasty, he overcame that monarch in a bloody engagement, and, as the fruit of that victory, took possession of part of his kingdom. At his death, Ariarathes V. assumed the sceptre of his father; married Antiochis, daughter of Antiochus the Great; joined that prince in a war against the Romans; beheld the confederated armies scattered by superior discipline and bravery; purchased the peace and friendship of the Romans by promising them 200 talents, which were mitigated to 100 at the intercession of the king of Pergamus; assisted his new allies against Perseus king of Macedon; and as the reward of his services, was stiled by the senate *the friend and ally of the Roman people.* His queen being at first barren, imposed upon his credulity, by persuading him that she had two sons, who were called Ariarathes and Holophernes; but afterwards, when she really became pregnant, she confessed the imposture, and bore to her husband two daughters, and a son who was called Mithridates. When this son arrived at manhood, his dutiful conduct inspired his father with such affection, as to induce him to resign the sceptre into his hand; but the son proved that he was worthy of his father's virtue, by declaring, that the only instance of disobedience which he would ever exhibit would be, to refuse a crown which his father wore with such honour to himself, and such happiness to his people, and thus merited the sirname of Philopater.

This prince, at the death of his father, ascended the throne by the name of Ariarathes VI., and signalized the beginning of his reign by an action no less glorious to his generosity than to his valour. Artaxias, king of Armenia Major, after having routed the forces of Mythrobuzanus, king of Armenia Minor, and forced him to seek an asylum at the court of Cappadocia, stained the glory of his victory by offering Ariarathes one half of the conquered kingdom, as a reward for taking away the life of the exiled monarch. The answer which the wounded virtue of the Cappadocian returned to this insulting proposal, was given on the field of battle, where he routed the forces of Artaxias; and, with a magnanimity bordering on rashness, restored Mythrobuzanus to his throne, though he had too great reason to dread the ingratitude of that prince, who soon joined Artaxias against his benefactor. When the confederates were about to invade his dominions, the Romans interposed; and in gratitude for the peace which their authority procured, he presented to the senate a crown of gold, who, in return, honoured him with a rod and chair of ivory. The cultivation of the arts and sciences in every part of his dominions dignified this interval of peace, which was soon interrupted by Demetrius Soter, king of Syria, whose sister Ariarathes had refused to marry, dreading the resentment of the Romans. As the instrument of his revenge, Demetrius incited Holophernes, who pretended to be the eldest son of the late king, to claim the crown of Cappadocia; and assisting him with the power of Syria, defeated Ariarathes and Eumenes, king of Pergamus, who, at the command of the Romans, joined him with his army, and having driven the former from his dominions, raised his rival to the throne. An appeal was made by both parties to the Romans, who, with their usual policy, adjudged the rivals to share the kingdom between them, without affording Ariarathes the means of recovering any part of his authority. Holophernes, however, soon shook the foundations of his power, by exercising it in acts of oppression, of cruelty, and of sacrilege; and Attalus, now king of Pergamus, espousing the cause of the exiled monarch, dissipated the forces of the usurper on the field of battle, forced him to abandon the country, and restored Ariarathes to the throne. When his affairs became doubtful, Holophernes had deposited 400 talents of gold with the inhabitants of Priene, a city of Ionia; and Ariarathes sullied the fame, which his former conduct had so justly merited, by employing his arms, and those of Attalus, in ravaging the territories, and besieging the walls of that city, because its inhabitants refused to surrender the treasure of his rival. The Priennians, however, not only conveyed the money to its owner; but defended the city till the irresistible mandate of the Roman senate, which they had solicited, arrived, and obliged the confederates to abandon the siege. Remembering former injuries, Ariarathes now entered into an alliance with Alexander Epiphanes, who, pretending to be the son of Antiochus, claimed the kingdom of Syria, and joining his forces to that impostor, attacked and defeated the army of Demetrius Soter, who was slain in the contest. Some time after he joined the Romans, who claimed the kingdom of Pergamus, in virtue of a will which Attalus had made in their favour; and along with P. Crassus, proconsul of Asia, attacked the army of Aristonicus, who, assisted by the Thracians and the Phocæans, asserted his right to that throne as the son of Eumenes. The avarice of Crassus, which directed all his efforts to save his booty, consummated the shame of his defeat, and defrauded his captivity of the pity of his country; but the death of Ariarathes, which was distinguished by the most intrepid bravery, did not cloud his former reputation in arms. The Romans, to repair the loss of that day, added Cilicia and Lycaonia to the kingdom of Cappadocia; and appointed Laodice, the widow of Ariarathes, during the minority of her children, to be regent. Intoxicated with the charms of royalty, and dreading the loss of her authority, she administered poison to five of the six children which were placed under her protection. The Cappadocians vindicated the honour of their country, by resisting the tyranny of the regent, and inflicting upon her that death which her crimes deserved.

Ariarathes VII. recalled by the Cappadocians at the death of his mother, ascended the throne, and married Laodice, sister of Mithridates, king of Pontus. This prince formed the ambitious scheme of annexing the kingdom of Cappadocia to his own; and employed a Cappadocian nobleman, named Gordius, privately to murder Ariarathes, that he might seize the country, under the pretence of acting for his sister. But his sister prevented him from reaping the fruits of his fratricide; for suddenly marrying Nicomedes, king of Bithynia, who had long meditated the invasion of Cappadocia, she instigated that monarch to accomplish his design, which he soon did by expelling the son of the late king, and assuming the supreme authority. Mithridates concealed his ambition by espousing the cause of his sister's children; and pretending to restore his nephew, defeated the forces of Nicomedes, and took possession of the kingdom. The glory which he acquired by this action, was soon converted into infamy; for refusing to resign the government to his nephew, he discovered the treachery of his designs, and roused the spirit of the Cappadocians; who, to avenge their wrongs, routed his forces, and placed Ariarathes VIII. on the throne of his ancestors.

This prince began his administration by concluding a peace with Mithridates; and, receiving from him a body of auxiliaries, prosecuted the war with Nicomedes, and wrested from him some of his provinces. Hostilities being thus happily terminated, Mithridates, trusting to his influence with Ariarathes, requested that monarch to recal Gordius from banishment, with the insidious design of again employing the dagger of that assassin against the Cappadocian king. Fear, and indignation, and revenge, roused the spirit of Ariarathes; and wielding the energies of his flourishing kingdom, he met on his frontiers the army of Mithridates, and disappointed the hopes which his enemy had formed of taking him unprepared. The gloomy soul of Mithridates had again recourse to his dark policy; and distrusting the issue of a battle, in which he could have commanded 80,000 foot, 10,000 horse, and 600 chariots, he expressed the strongest desire of reconciliation; and inviting Ariarathes to a conference to settle all differences, plunged in his unsuspecting bosom a dagger, which he had concealed in his garments. The Cappadocians, who witnessed this perfidious action, were struck with consternation; and, instead of avenging the inglorious blow, fled from the field. The regicide, by placing the Cappadocian sceptre in the hand of his son, a boy of eight years of age, completed his own triumph, and the degradation of that unhappy country. But when Gordius was recalled, and appointed governor, the spirit of the people, which was depressed but not extinguished, resented the insult; and recalling from Asia, where he had been exiled, the brother of their late king, placed him upon the throne, by the name of Ariarathes IX. and expelled his rival. But Mithridates, to revenge that affront, again invaded Cappadocia with a mighty army, and meeting its monarch on the field, routed his forces, drove him from his dominions, and restored his own son. The exiled prince soon after died of grief, and was the last of the family of Pharnaces who governed that country.

At this time, the Bithynian prince had again recourse to the influence which his marriage with the widow of of Ariarathes gave him, to overturn the power of Mithridates in Cappadocia. For this purpose, he asserted that Ariarathes had by Laodice three sons, and that the youngest, who had concealed himself that he might elude the fate of his brothers, was still alive in the Bithynian court. Laodice, with a young man whom she acknowledged as her son, went to Rome, and claimed in his behalf the protection of the Romans. The address of this artful princess imposed upon the wisdom of the senate; but scarcely had they promised their assistance, when Gordius, in the name of Mithridates, appeared before that august assembly; discovered the imposture of Laodice; and, with a tale equally deceitful, maintained that the prince, whom Mithridates had placed on the throne of Cappadocia, was a son of Ariarathes VI. The senate perceived the falsehood of both parties, and indignant at the insult which they had offered to their wisdom, by endeavouring to deceive them, commanded Mithridates to abandon Cappadocia, and Nicomedes Paphlagonia; and gave their freedom to both these states. The Cappadocians, however, requested the liberty of electing a king to themselves, which was granted by the senate, and Ariobarzanes was raised to the throne by the voice of his country.

This prince soon found that he had sacrificed his happiness for the splendor of royalty. Mithridates, and Tigranes, king of Armenia, drove him from his throne, and restored the kingdom to the son of the former. Flying to Rome for protection, the senate commanded Sylla to reinstate him upon the throne; and that general, having defeated the numerous army of Gordius, obeyed their command. Again was Ariobarzanes expelled from his dominions by Mithridates; again was he restored by the arms of Sylla; again was he driven to Rome, and the country swept of its inhabitants by Tigranes, who planted them in Armenia; and again was the exiled monarch restored by the Romans under Pompey, who added to his dominions Sophene, Gordiene, and part of Cilicia. Regretting the tranquillity which he enjoyed when a subject, the Cappadocian monarch completed the vicissitudes of an eventful life, by resigning the sceptre into the hands of his son.

Ariobarzanes II. inherited the kingdom of Cappadocia and the protection of the Romans; and, what is no less honourable to his fame, he acquired the friendship of Cicero when proconsul of Cilicia. At that time a conspiracy was formed against him, at the head of which was the high priest of Bellona, a man who was second only to the king, and who, both from his birth and office, could command a numerous army to take the field. But Cicero not only informed the king of his danger, but exerted his authority to avert the storm, and induced the head of the conspiracy to leave the kingdom. When the empire of the world was afterwards decided on the plains of Pharsalia, Ariobarzanes, who, from gratitude, assisted Pompey, not only shared in the defeat of the vanquished, but also in the clemency of the victor, who accepted of his submission, and demanded a large subsidy as the price of reconciliation. He, however, endeavoured to elude the demand, by declaring that his treasury was exhausted, by repelling an invasion which had been made upon his dominions by Pharnaces, king of Pontus. Cæsar, therefore, after having terminated a war with the Egyptians, sought and routed the forces of Pharnaces; and having despoiled him of his Cappadocian provinces, restored them, with part of Cilicia and Armenia, to Ariobarzanes. The resentment of Brutus and Cassius, whose fortunes Ariobarzanes now abandoned, was roused against him; and the latter, having routed his troops, and taken himself prisoner, put him to death, and, as he left no children, the crown remained to his brother.

This prince, who is known by the name of Ariarathes X., did not immediately ascend the throne. Sisinna, son of the high priest of Comana, and a descendant of Archelaus, who, though a Cappadocian, had acted as a general under Mithridates, laid claim to the sovereignty, in virtue of a donation from Mark Antony. This Roman, who seemed born to be the sport of passion, had formed an attachment to Glaphyra, mother of Sisinna; and, as the price of her virtue, received the kingdom of Cappadocia for her son. His reign, we know, was short, but his fate is uncertain. Ariarathes now ascended the throne, but at the end of five years, he was driven from his dominions by Antony, who, led by his illicit passion, gave the sceptre to Archelaus, the second son of Glaphyra.

This prince testified his gratitude to his benefactor, by assisting him in his war with Augustus; and, in the fatal battle of Actium, partook of his danger and defeats. But at the earnest request of his subjects, he was pardoned by Augustus, and allowed to keep possession of his kingdom. He afterwards received Armenia Minor and part of Cilicia for assisting Tiberius in restoring Tigranes to the throne of Armenia Major; but the most valuable reward which he gained, was the friendship of Tiberius, who used all his influence in his behalf when he was accused by his own subjects before the emperor, and who thus saved him from destruction. He next extended his influence, by marrying Pythodoris, widow of Polemon, king of Pontus; which kingdom he governed in right of his wife during the minority of her children; and, likewise, by giving his daughter Glaphyra in marriage to Alexander, son of Herod the Great, king of Judah, with whom he had contracted an intimate friendship. But when Tiberius, to shun the hatred of the sons of Agrippa, and of their grandfather Augustus, obtained from the emperor the liberty of retiring to Rhodes, in a kind of honourable banishment, Archelaus forgot his former benefactor, whose friendship he now deemed dangerous; and paid all his court to his rival, Caius Cæsar, who, when governor of the East, was looked upon as heir to the emperor. When Tiberius afterwards ascended the throne, he made Archelaus feel his resentment, by summoning him to Rome to answer for his conduct. It is said that Livia seconded her son's revenge against the unhappy prince, by informing him that his personal submission to the emperor would mitigate his resentment, and obtain forgiveness. Archelaus, ignorant of the snare prepared for him, or not daring to disobey, hastened to Rome; and being accused before the senate of fictitious crimes, was so overwhelmed with age and indignities, that he was reduced to a state of either real or assumed insanity, which soon terminated in his death, after a reign of 50 years.

Cappadocia was now annexed to the Roman empire, and its independence was for ever extinguished. When the neighbouring nations sunk into the same state of degradation, Paphlagonia and Pontus enlarged the bounds of this province, without adding to its fame, or enabling its enslaved inhabitants to recover their liberty. At a later period it was divided into ten prefectures; but when Constantine the Great ascended the throne, he reduced it to its ancient extent, by forming the territories which had been annexed to it into separate provinces. When Alexis Commenus founded the empire of Trebizond, in 1209, Cappadocia was subjected by his arms; but when this empire was overthrown by the Turks, the subject of this narrative became a part of their dominions, and under their power it still remains. It is now called Amasia, from the city of that name, which is situated in that province, and where the Turkish beglerbey sometimes resides.

The annals of this country have not transmitted to us any particular account of its government; but we have reason to conclude, that the will of the prince was, in most cases, the rule of his conduct; and when this did not take place, the laws of Charondas, a celebrated legislator of Greece, prevailed. Their religion seems to have been a mixture of Persian and Grecian superstitions; which, instead of promoting the happiness of the state, by favouring useful employments, crowded in one temple, sacred to Jupiter, no less than 3000 ministers, to loll in luxurious apathy, or to plot in ambitious cabals; and, instead of inciting its votaries to praise God by the practice of virtue, incited them to practise the most senseless penances—to lacerate their bodies in honour of Bellona; and, if we can credit antiquity, to offer human sacrifices to Diana, and some other idols. The Cappadocians proved that the religion of a country directs its morals, when their wickedness becomes so proverbial, that the neighbouring nations denominated every person distinguished by his depravity, a Cappadocian, as a term of peculiar reproach.

This country was never remarkably distinguished for learning or science; but the writings of Strabo and Pausanius, of Basil, and Gregory Nazianzen, illumined the darkness of their horizon with a splendor which has continued to our day. In the later period of this kingdom, its armies were numerous, its revenues large, and its commerce considerable; but from the time that it became a province of Rome, its spirit in a great measure was broken, and its energies were paralised. See *Diodor. Sicul.* lib. xviii.; *Strabo*, lib. xi. xii.; *Curt.* lib. xii.; *Liv.* lib. xxxvii. cap. 21, 37, 38, 39, 40; lib. xlii. cap. 19. epit. 46, 47; *Justin.* lib. xxxv. cap. 1. lib. xxxvii. cap. 1. lib. xxxviii. cap. 1, 2; Cicero, *Epist.* passim; Tacit. *Ann.* lib. ii. cap. 42, 56, *Hist.* lib. i. cap. 78; Joseph. *Ant.* lib. xvi. cap. 8. *Bell.* lib. i. cap. 25, 35; *Univers. Hist.* vol. iii. p. 761; Rollin's *Anc. Hist.* vol. ii. p. 5, vol. vii. p. 13, vol. ix. p. 344; Prideaux's *Con.* vol. iii. & iv. passim. (J. N.)

CAPPARIS, a genus of plants of the class Polyandria, and order Monogynia. See BOTANY, p. 228.

CAPRARIA, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 244.

CAPRI, formerly CAPREÆ, is an island of the Mediterranean, situated on the south side of the Bay of Naples, and separated by a narrow channel from Cape Campanella (the *Promontorium Atheneum*, or *Minervæ*, of the ancients), the extremity of the tongue of land which forms the southern boundary of the bay, and separates it from the semicircular gulf of Salerno.

The island of Capri, which is of a triangular form, is about eight miles in circumference, and is distant from the coast of Naples about three Italian miles. Its appearance at a distance is extremely wild, from the steep cliffs and huge masses of rock; but this wildness is softened down, upon a nearer approach, by the appearance of patches of verdure, and clusters of white houses. A great part of the island is uncultivated, and incapable of cultivation; but wherever the hoe could be used, the ground is well tilled, and produces the richest crops. Near the palace of La Marina, the soil, which is extremely rich, consists of a deep stratum of good mould, over a yellow bole beneath, which is a stone similar to the tufa of the volcanic hills round Naples. The upper rocks of Capri, as we learn from Swinburne, are universally calcareous, and the strata accord with those of the Sorrentine mountains on the Continent, from which the island appears to have been separated by some great convulsion. Mr Swinburne supposes, that "the lower tracts of land in Capri have been thrown up by fire in the midst of limestone mountains, in the same manner as the plain of Sorrento." The district of Anacapri, which is separated by rocks from the rest of the island, lies on a declivity inclining to the north, and bounded by a high and rocky shore. The communication between this and the other part of the island is kept up by a long flight of rude steps, winding up a cliff of tremendous height; and though the steps are very slippery, yet loaded asses are able to ascend and descend with safety. The southern and eastern sides of the island are flanked with rocky precipices of enormous height. The principal places in the island are Capri and Anacapri. Capri is situated in a low but fertile spot of land, between two rugged eminences of great height, which form the extremities of the island. At a distance its cupolas and buildings give it the appearance of a considerable place, though it is only a small village. Anacapri is a small town, composed of a few streets and scattered houses, with a nunnery and a parish church, embosomed in groves of fruit trees, and encircled with luxuriant and well kept gardens.

At the chapel of Santa Maria, now inhabited by a simple unlettered Anchoret, stood the summer palace of Tiberius, who spent the greater part of ten years in this delightful retreat, abandoned to the most unhallowed debaucheries. See TIBERIUS. This emperor built twelve villas, in different situations, and dedicated them to the twelve greater gods. Extensive vaults and reservoirs at Santa Maria, the ruins of a lighthouse, and two broken columns, are almost the only remains of these ancient villas.

The winter residence of Tiberius at La Marina is still indicated by columns and fragments scattered on the sand. The conduit, from which the palace was supplied with water, is still to be seen; and Mr Swinburne is of opinion, that a semicircular recess of net-work, the *opus reticulatum* of Vitruvius, which is raised against the cliff, once formed a part of the theatre. "In an adjacent vineyard," says that traveller, "some peasants were removing a pavement of black and white mosaic. The ruins stretch far into the sea, and that element has now resumed the territory from which it had formerly been expelled by the force of terraces and piers. The palace was built of this stone (tufa,) but in its coarser parts, such as abutments and back walls, are inserted large pieces of lava in a rough state of torrefaction, like that of the crust of Vesuvian streams when cooled."

On the southern shore the Carthusians have a very spacious convent, founded in the reign of King Robert, by James Capri, a veteran commander. Terraces, supported by vaults, called Botteghe, or the shops of the ancients, are cut in the opposite hill, and tufts of caper bushes, laden with purple and white flowers, mingle most happily with the ruined arcades.

The island of Capri abounds with various birds of passage, but particularly with quails. The greatest part of the bishop's income is derived from the taking of these, and of other kinds of game, and hence the island has been called the Bishopric of Quails. "Across every track in the woods," says Swinburne, "or chasm in the hills, rows of nets are placed to intercept stock doves and quails in their annual flights; the quantity taken of each sort, especially the latter, is almost incredible. I have the best authority for saying, that, even in bad years, the number of quails caught in Capri amounts to 12,000; in good years it exceeds 60,000; and in one remarkable year, one hundred and sixty thousand were netted; eight years ago, in the month of May, 45,000 were taken in the course of a single day." East Long. 14° 10′, North Lat. 40° 32′. See Swinburne's *Travels in the Two Sicilies*, 2d edit. vol. iii. p. 1—12; and *Nuova Guida de Forestieri per l'antichita Curiosissime di Pozzuoli, dell' isole adjacenti d' Ischia, Procida, Nicida, Capri*, &c. Naples, 1751, 12mo. (π)

CAPRICORN, or the GOAT, is the name of one of the 12 signs of the zodiac. As the sun when it enters this sign ascends towards the north, like the goat when it climbs the sides of mountains, some authors have ascribed the origin of the name to this fanciful resemblance. In Ptolemy's catalogue this constellation contains 28 stars; in Tycho's 28; in Hevelius's 29; in Flamstead's 51; and in the catalogue printed in the article ASTRONOMY, p. 724, we have given the position of 54 of the principal stars. (*w*)

CAPRIFICATION, the name of a method of ripening the fruit of the domestic fig-tree, by means of the cynips, or fig fly, practised in the islands of the Grecian Archipelago. Those insects which are produced from the winter figs of the *caprificus*, or wild fig-tree, are gathered by the peasants in the months of May and July, and are deposited on the fruit of the garden fig-trees

They enter the fruit by the eye; and the worms produced from the eggs which they lay, puncture the fruit, and not only accelerate the maturation of the fruit, but render it of a much larger size. Olivier, who resided long in the Archipelago, considers all this as founded on a vulgar error; and maintains that the practice is discontinued in several of the Grecian islands. In a subsequent part of our work, we shall have occasion to resume this subject at greater length. See Tournefort's *Voyage au Levant*, and the *Nouveau Dictionnaire d'Histoire Naturelle*. (π)

CAPRIFOLIA. See Botany, p. 74.

CAPSICUM, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 138.

CAPSTAN. See Crane.

CAPSULE. See Botany, p. 41.

CAPTION, in the law of England, is a certificate subscribed by commissioners, declaring when and where the commission was executed. These captions relate chiefly to business of three kinds: to commissions to take fines of land, to take answers in chancery, and depositions of witnesses. All these captions, and the execution of the commissions, must now be in English, by the statute 4 Geo. II. Jacob's *Law Dict.*

Caption, in the law of Scotland, is a letter running in the king's name, and under his signet, containing a command to messengers and to magistrates to apprehend and imprison a debtor, who has disobeyed the charge given him on letters of horning. These letters pass on the warrant of a bill to the court.

Peers and married women are by law secured against personal execution by caption upon civil debts; and pupils, by special statute, 1696, c. 41. No caption can be executed against a debtor within the precincts of Holyrood-house.

Letters of caption contain an express warrant to the messenger, if he cannot get access, to break open doors, and other lock-fast places, where he suspects the debtor may lie concealed. See Erskine's *Institutes*, b. iv. tit. iii. § 12, 13.; Bell's *Dict. of the Law of Scot.* (z)

CAPUA, a city of Naples, in the province of Lavora, is situated in a pleasant and fertile country, on the left bank of the Volturno, about 12 miles from the sea. The present town occupies a site about two miles distant from that of ancient Capua, which stood near to Mount Tifata. The streets are more spacious and airy, and the houses, many of which are built from the materials of the ancient city, are more elegant than those in other parts of the kingdom. As Capua is the only fortification that covers the approach to Naples, it has been rendered a pretty strong place. Its fortifications, which are good, consist of bastions, ravelines, and other works, and are covered with freestone. The river and the castle likewise contribute greatly to its strength. Besides the cathedral, which contains two fine pieces of sculpture by Bernier, Capua has one collegiate church, 16 parish churches, and 12 convents. There is a great number of ancient inscriptions, which have probably been brought from the ruins of the ancient towns. The population is about 8000. East long. 14° 9′ 30″, North lat. 40° 7′. See Carthage. (w)

CAPURA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 178.

CARABAYA. See Buenos Ayres, p. 778, 782.

CARABUS. See Entomology.

CARACALLA, the appellation by which Marcus Aurelius Antoninus, a Roman emperor, is generally known, though it was given to him as a mark of reproach, on account of his silly fondness for a Gaulish robe called by that name, which he himself usually wore, and which he distributed gratuitously among the soldiers and inhabitants of Rome. This infamous person was the son of Severus and Julia Domna. He was born in A. D. 188; invested with the dignity of Cæsar in 197; proclaimed "Augustus" in 199; and in 202, when he was only 14 years of age, in consequence of a successful war against the Jews, in which he held the title of commander, he had a triumph decreed him by the senate, he put on the *toga virilis*, and was appointed colleague to his father in the consulship. In the following year he married, contrary to his inclination, the daughter of Plautianus, the prætorian prefect, whose abuse of the power with which, as a favourite, he was intrusted, was ultimately the cause of his own death, and of the ruin of his whole family.

Severus died A. D. 211, and was succeeded by Caracalla and his other son Geta, both of whom he had raised to the sovereign power during his lifetime, and whom he nominated in his last will as his joint successors on the imperial throne. The ambition of Caracalla had scarcely allowed him to wait for this event. He hated Geta, who also hated him in return. Indeed, this mutual antipathy had begun when they were children: it increased as they grew up; and gave much distress to Severus, who adopted, but in vain, every method of promoting between them, if not a complete reconciliation, at least a mutual forbearance. It was for the purpose of allaying the animosity which he could not remove, that he took them along with him in his military expedition into Britain. But Caracalla, whose dark and savage mind was wholly unsusceptible of generous emotions, disappointed the expectations of his father, and, equally unmoved by the scenes of martial glory in which he acted, and by the continual expressions of parental affection which he experienced, he thought of nothing but of raising himself to the supreme power, by the destruction both of Severus and Geta. He endeavoured to prevail upon the army to acknowledge him as sole emperor. He attempted to murder his father. He then intrigued with the officers and soldiers to get him deposed. And failing in all these infamous measures, finally tried to hasten his death, by bribing the physician who attended him in his last illness.

No sooner had Severus expired, than Caracalla renewed his unjust and diabolical acts against Geta. But the army, from respect for the appointment of their late emperor, refused to enter into his views; and two violent attempts to murder Geta, one of them made during their progress homeward, and the other during the Saturnalian festival, proved unsuccessful. At length, however, he accomplished his guilty purpose, under the mask of returning friendship. Having persuaded Geta to meet with him in a private apartment on terms of peace, he introduced some centurions, who had been previously hired and tutored, and who assassinated Geta in the very arms of his mother; Caracalla himself standing by and instigating them to the bloody deed, or rather assisting in the perpetration of it, as appears from his afterwards consecrating, in the temple of Serapis at Alexandria, the very sword which he had used on that occasion.

The remainder of Caracalla's life was characterised by the same infamous duplicity and savage cruelty which had thus enabled him to attain the sovereign power. He persuaded the army, by the most unfounded pretences, that he had acted in self-defence; and compelled the senate, by demonstrations of violence, if not to believe in his false statements, at least to approve of his conduct. And in order to satisfy the people, he, with a strange inconsistency, permitted the memory of his brother to be so highly honoured, that by a decree of the senate, who were ready for every base compliance, he was enrolled among the gods! His detestation of Geta, however, appeared in a thousand ways. Not only was all the money bearing Geta's name melted down, and the inscriptions erased, but all his domestics and friends, some say to the number of 20,000, were inhumanly massacred, without regard to age, or rank, or sex; and the mere mention of his name, even on the stage, where it was familiarly applied to slaves, was punished as a capital crime. Caracalla now wantoned in barbarity, gratifying his malignant passions without remorse, extorting money from the people without any regard to their circumstances, and squandering what he thus procured by rapine and oppression, on pursuits the most unworthy, and pleasures the most ignoble. There was in his whole behaviour such a contempt of principle and reputation, such a uniform disregard of every quality and every action which could excite one feeling of genuine respect among his subjects, or lighten in the least degree those deep shades of guilt by which his general deportment was darkened, that we are at a loss to determine whether he was more the victim of mental derangement, or the slave of innate depravity and profligate habits. If any thing be wanting to render his character completely odious and contemptible, it may be found in his affected zeal for chastity and religion, in the midst of the most shocking impiety, and of the grossest debaucheries.

Such was Caracalla, when he resolved to imitate Alexder the Great, for whom he professed the greatest veneration, but whom he resembled in nothing that was laudable or good. He left Italy in 213, and engaged in a series of warlike expeditions, which were distinguished neither by honour nor success. In Gaul, which he visited first, he was abhorred for his cruelty. The Catti and Alemanni whom he attacked, compelled him to purchase an inglorious peace, and the liberty of returning into his own dominions. And the rest of the nations in Germany, encouraged by this circumstance, took up arms and obliged him to grant them yearly pensions, for the payment of which he embraced the dishonourable, but necessary, expedient of coining false money. To compensate for these disgraces, he put all the youth of Noricum to the sword, after having ordered them to take up arms and join him; and for this perfidious massacre, which he affected to call a signal victory, he assumed the title of Alemannicus. Having gained some paltry advantages over the barbarians on the lower Danube, and entered into an alliance with the Dacians, he went to Ilium to pay his devotions at the supposed tomb of Achilles; and there he poisoned his favourite freed man Festus, that he might get up a funeral resembling that of Patroclus, and thus imitate the Grecian hero in affection and respect for his departed friend!

He next procured the unwilling submission of Artabanes king of Parthia, and, by an act of the basest perfidy, got the kings of Edessa and Armenia into his power. And though these advantages were far more than counterbalanced by the defeat of his general Theocritus, and the disgrace which he himself brought on the arms and character of Rome, he scrupled not to write letters to the senate, boasting of his exploits, and glorying in his success. Having gone to Alexandria, he reduced that flourishing city to a state of desolation. The Alexandrians had formerly, it seems, thrown out some sarcasms against him on account of his folly. This kindled in his savage breast the flames of hatred and resentment, which could not be quenched except in the blood of the people, who had thoughtlessly offended him. And that his revengeful purposes might be more easily and effectually executed, he proceeded to the accomplishment of them in the most deliberate manner, and under the guise of piety to the gods, and friendship for the devoted inhabitants. He proposed to render personal homage in the temple of Serapis, and peculiar honours at the tomb of Alexander; and, in doing this, he sacrificed whole hecatombs, burnt a great quantity of incense, and engaged in ceremonies of the most pompous and imposing kind. But when the people, flattered by the presence and the condescension of the Roman emperor, and little suspecting that any treachery was lurking in the heart of the imperial devotee, had assembled to gratify their curiosity, and indulge their superstition, by witnessing or engaging in the festivities of the day, the soldiers of Caracalla, at his signal, suddenly fell on the unthinking multitude, and involved them in one dreadful indiscriminate slaughter. This cruel and perfidious massacre was succeeded by a universal pillage, and by severities of the most wanton and atrocious kind—those who fell, and those who escaped the carnage, being, according to the letters of its infamous author, equally deserving of punishment. From this tragic scene, Caracalla directed his steps towards Parthia, and determined, on a pretext equally false and feeble, to break the peace which subsisted between the two empires. He marked his progress by ravaging the country through which he passed, plundering the cities, despoiling the inhabitants, and even violating the repositories of the dead. His presumption was equal to his barbarity; for though he had never seen the Parthians, and received no proofs of submission, he pretended, in his communications to the Roman senate and people, that he had conquered them, that he had subdued all the East, and compelled every nation on the other side of the Euphrates to acknowledge their authority. The senate and people, in consequence of this alleged success, decreed him a triumph, and granted him the appellation of Parthicus.

Caracalla intended to renew the war next season. But while pursuing his journey from Edessa, where he had spent the winter, to Carrhæ, where he proposed to offer a sacrifice in the temple of the Moon, he was assassinated by a centurion, at the instigation of M. Opilius Macrinus, a prætorian prefect. This event happened in 217, when Caracalla was in the 29th year of his age, and had reigned only a little more than six years. The record of his short life is so full of crimes and follies, as to have the appearance of a libel on human nature. How melancholy to add, that this monster in the moral world had divine honours decreed to him by the Roman senate, and had a temple, with all its solemn appendages, established for his worship in the capital of the Roman empire! See Crevier's *History of the Emperors*; Gibbon's *History, &c.*; *Dion Cassius*; *Herodian*, &c. (τ)

CARACCAS,

An extensive district in the eastern part of Terra Firma, in South America, comprehending the province of Venezuela in the centre, the government of Maracaibo on the west, Guiana on the south, the government of Cumana on the east, and the island of Margaretta on the north-east. This district is bounded on the north by the Atlantic ocean, from 72° 35′ to 60° west longitude, that is, from the Cape de la Vela to the point of Megilones or Paria; the ocean likewise forms its eastern boundary, from 12° to 8° of north latitude; on the south it is bounded by Dutch Guiana and Peru; and on the west by the kingdom of Santa Fe.

A country extending from the twelfth degree of latitude to the equator, might be expected to suffer all the relentless severity of a tropical sun. In some places, indeed, the heat of the torrid zone is felt without any abatement; but in a great proportion of this wide province, the inhabitants enjoy the mildness of a perpetual spring. This peculiarity of temperature is occasioned by the link of a chain of mountains, which, commencing at one of the Andes of Quito, traverses Merida and the government of Varinas, then stretches to the north as far as the coast, and, taking thence an easterly direction, insensibly diminishes in height till it finally loses itself in the island of Trinidad. That part of the chain which traverses the district of Caraccas, is, in its ordinary breadth, fifteen leagues, in some points twenty, but no where less than ten. In general the elevation of these mountains is so moderate, that they are not only habitable, but susceptible of all the operations of agriculture. The eastern Picacho alone, towering in sullen majesty to the stupendous height of 1278 fathoms, bids defiance to the efforts of human industry. Next to it in grandeur is the Tumeriquiri, which rises 935 fathoms above the level of the sea. The variety of temperature which these eminences produce, is extremely favourable to the diversity of vegetable productions.

After passing these mountains from north to south, we find immense plains stretching from east to west, from the village of Pas, in 64° 35′ of west longitude, to the bottom of the mountains of Santa Fe. In these plains, which are bounded on the south by the river Oronoko, the heat is so intense as to be nearly intolerable. The strong vegetation which prevails in general upon these mountains, and the calcareous substances with which they abound, seem to prove, that they are of the second order of mountains; accumulated strata of different substances, formed by various revolutions of the globe, or by violent convulsions of nature. Yet, upon the Saddle mountain, the highest of that chain, Baron Humboldt has found some fine granite, of which quartz, felt-spar, and mica, are the constituent parts; a clear indication, according to the same system, that this mountain, at least, is either primitive, or has emerged at a much earlier period than its companions from the bosom of the waters. Whatever support may be derived from the structure of these mountains to any, or to both of the contending theories, by which geologists are at present so keenly agitated, they afford at least to the agriculturist, in the rich variety of their productions, a field of speculation and of industry, amply sufficient to occupy his time, and to gratify his fondest hopes of gain.

The gradual changes of temperature, the delightful blending of the seasons, which so agreeably diversify the year in the temperate climates of Europe, are unknown to the inhabitants of the Caraccas. Winter and summer here complete the year: nor are these seasons distinguished so much by the various degrees of heat and cold, as by the rains which prevail during the former, and the drought by which the latter is characterized. The rainy season, or winter, continues from the end of April to the beginning of November; during the six remaining months, which constitute summer, the rains are less frequent, and in some years even rare. There are some days, even in the rainy season, when not a drop falls; but there are others, though not very frequent, when it rains incessantly. M. Depons calculates that, taking one day with another, it rains for the space of three hours each day; and oftener in the evening than in the morning. The quantity of rain which falls during that season, is nearly equal in the provinces of Venezuela, Cumana, and Guiana; and the benefits and disadvantages which the rains bring along with them, are participated by the plains, mountains, and vallies. The drizzling rains of the polar regions are never seen in this part of South America; nor can an inhabitant of countries even within the temperate zone form any adequate idea of the sudden heavy falls common in these latitudes; the discharges from water-spouts rushing down with the violence of a torrent, and producing more moisture in a single day than the rains of Europe do in six. During the greater part of the rainy season, all the rivers inundate the adjacent plains; channels, formed by the violence of the floods, which remained dry during the rest of the year, are now converted into torrents, and overflowing their banks to an immense distance, form a kind of temporary sea, where the traveller can descry only the tops of the loftiest trees, which then serve him as landmarks. The northern plains of the Oronoko are overwhelmed by such an annual deluge, to the extent of one hundred and fifty leagues in length, and forty in breadth. Previous to the year 1792, the rains were uniformly accompanied with vivid lightnings and tremendous peals of thunder; since that period, however, at least till 1804, rain falls in great abundance without any of the usual accompaniments of a storm. The atmospheric electricity appears to have been attracted and accumulated in that mass of matter which forms the Corderilleras; and to this cause are to be ascribed those earthquakes which were so dreadfully experienced at Cumana, in the month of December, 1797. (See Cumana.) Though placed between the Antilles, where earthquakes are frequent, and Peru, where they are still more so, Caraccas enjoys intervals of repose, which we might be disposed to consider as almost miraculous, did we not know, that its air being less rarefied, gives less action to electricity, and that its soil contains in its bosom a smaller portion of the principles of fermentation and combustion. On the 1st May 1802, at eleven o'clock in the evening, there was a pretty strong shock felt at Caraccas, with an oscillation from west to east. On the 20th of the same month, at five minutes past four o'clock in the afternoon, there was another of a vertical direction, which lasted one minute, nor did the earth resume its horizontal position for two minutes afterwards. Two strong shocks were experienced on the 4th July following, at 48 minutes past two o'clock in the morning; and nearly two hours after, there was another, not so strong. A dreadful earthquake has lately (March 26th 1812) desolated La Guayra and Caraccas; by which many public and private buildings have been thrown down, and an incredible number of the inhabitants are said to have perished. The local origin of these earthquakes appears to be in the province of Cumana, for they are there more violent than in any other part of the district of Caraccas.

The natural history of a country, which, since its first discovery, has been occupied by Spaniards, indolent, void of curiosity, and extremely jealous of the visits of foreigners, is, of course, very imperfectly known. The avidity of its first conquerors was exclusively directed to the discovery of gold and silver mines. Four gold mines were found, after a long and anxious search, and were wrought under the name of the royal mine of St Philippe de Buria. They were abandoned, however, in the year 1554, in consequence of a revolt of the negroes who wrought in them, and of the natives, who now foresaw, in the establishments of the Spaniards, their certain subjection to tyrannical masters. To renew these works, became the favourite enterprize of several successive governors. With this view, Governor Villacinda built a city which he called Palmes, the first year after the revolt; but it was scarcely finished, before it was destroyed by the Indians. A similar attempt was made, six months after, by Paradas, which was equally unsuccessful; he built the city of Nirgua, which he was soon compelled to evacuate. Gutierres de la Pegna built another city, with the same design, on the banks of the Nirgua, in 1557; for some years it withstood the attacks of the Indians, who at length, however, in 1568, succeeded in reducing it. Another mine was discovered in the environs of the city of St Sebastian de los Reyes; but, when Governor Collado began to attend to the erection of its works, an insurrection of the Indians caused it to be abandoned. A deceitful peace, which was concluded with the Cacique Guaycaypuro, seemed to afford a favourable opportunity for the renewal of these works; but they had not proceeded far, when a multitude of Indians, falling upon them unexpectedly, massacred all the workmen, and demolished the works; nor has any future attempt been made for their establishment. At Apa and Carapa, not far from the banks of the Tuy, Sebastian Dias discovered, in 1584, two mines, where the gold was very abundant, and at twenty-three carats. The country was so extremely unhealthy, however, that it became indispensably necessary to abandon treasures, which could not be procured without a much larger sacrifice of men than the colony could then afford. The reputed richness of these mines again tempted the avidity of Sancho Alquisa, in 1606; but the works had been so completely destroyed by the Indians, that, after the most anxious search, not a vestige of them could be traced. In 1698, Governor D. Francisco Berrocaran made similar efforts, and with similar success. Yet the Spaniards of Caraccas, thus unfortunate in their attempts to work the gold and silver mines, possess, in the jurisdiction of St Philippe, mines of copper of a very superior quality, which, besides supplying the planters with the best materials for their boilers, cylinders of mills, and other implements, had furnished 171 quintals for exportation in 1804; and the quantity would have been much more considerable, but for the war.

Had the Spaniards been attentive or scientific observers, their search after mines would have made them acquainted with many important facts relating to the strata and mineralogy of the Caraccas. But such facts, however they might gratify the curiosity of geologists, could excite no interest in men whose curiosity sprung entirely from avarice, and who never thought of penetrating beneath the surface of the earth, except for the discovery of the precious metals. We knew scarcely any thing, therefore, of the mineralogy of this district of Terra Firma, until it was lately explored by Baron Humboldt. According to his observations, it is composed of nearly the same strata as the ancient continent. On the Saddle Mountain of Caraccas, 360 toises above the level of the sea, he found folicular granite. He found it also at Cape Codera, at the height of 141 toises; and of this granite, he assures us, the whole coast is composed, from the Unara river to Santa Martha. The mountain of Capaya he found to be composed of a granite which changes into slated talc, vitriolated feldspar, slated chlorite, limestone grained with mica, rock crystal, primitive green rock, silvered galena, quartz, magnetic sand, red oxide of crystallized titan, quartz mixed with black lead. Porcelain earth, argillaceous earth, &c. are found scattered in the provinces in the same manner, and in the same proportions, as in Europe. Argillaceous earth is found in the greatest quantity. The whole coast north of the province of Venezuela furnishes salt of a beautiful whiteness; and that in the salt pit of Araya, in particular, may vie with any in America, not even excepting Turk's Island. This salt pit consists of a mixture of fossil and marine salt. But the Spaniards, with their characteristic indolence, almost entirely neglect the working of it; so that they do not derive from it the one-hundredth part of what it might produce. The provinces of Caraccas abound likewise in mineral waters, both hot and cold. They are of various qualities, such as the ammoniacal, the ferruginous, the nitrous, and even the acidulous. The heat of some of these waters approaches to that of boiling water. Between Porto Bello and Valencia there are springs which rise to the seventy-second degree, and there is another still hotter in the vallies of Aragua.

On the first discovery of this country, the Spaniards, disappointed in their expectation of wealth from its mines, engaged eagerly in the pearl fishery, which, for some time, was the most considerable source of their riches, and the most important branch of the royal revenues. This fishery was carried on between the islands of Cubagua and Margaretta, at the expence of a great many lives, both of Spaniards and Indians. Several other untoward circumstances caused them at length to abandon their fishery, which has never been resumed. It is even pretended, that the pearls have disappeared from the eastern coast; and the first place on the leeward, where that fishery is carried on with some success, is a bay situated between Cape Chichibacoa and Cape de la Vela, occupied by the Guihiros Indians, who sell their pearls to the Dutch and English.

The luxuriant soil of the Caraccas yields an exhaustless store of the most valuable vegetable productions. Its mountains are clothed with forests, consisting of all the kinds of wood to be found in the Antilles, besides a great many species peculiar to themselves. The most extensive ship-yards might be supplied for ages from these mountains with timber of the finest quality; and carpenters and cabinet-makers find such variety of materials for their different purposes, that their principal difficulty is to make a selection. The wood called by the Spaniards Pardillo, is generally used for beams, door frames, and posts. In some places, instead of the pardillo, they substitute a species of very hard oak, which is the *quercus cerus* of Linnæus, and the *quercus gallifer* of Tournefort. Cedar is much employed by cabinet-makers for doors, windows, tables, and common chairs. For ornamental furniture, they have several kinds of wood susceptible of the highest polish. Of these, the most distinguished is the black ebony, which abounds in several places, but particularly on the banks of the Totondoy,—a spot apparently intended by Nature as the nursery of those trees which contribute most to the necessities or to the pleasure of man. Yellow and red ebony are both very common in the forests of Terra Firma; but mahogany is neither so abundant here, nor so fine, as in that part of St Domingo which Spain has ceded to France; yet, in richness, and variety of colouring, no mahogany can vie with the chacarandy, a native of Caraccas, which, when properly polished, possesses a degree of beauty which no species of timber, perhaps, can exceed. For works which require timber of extraordinary hardness, they employ iron-wood, the *ybera puterana* of Marcgrave; or red ebony, which is even harder than iron-wood. The only wood for dyeing which has yet been found in Caraccas is the Brazil wood; but, in truth, the forests of this favoured country have been so little explored, that their treasures are very imperfectly known.

Almost every part of this district abounds in medical plants, gums, resins, roots, and barks, which, if duly attended to, would augment incalculably the riches of the inhabitants, and produce the most essential benefits to mankind. The quantity of sarsaparilla which grows here is more than sufficient for the consumption of the whole of Europe; sassafras and liquorice abound in the neighbourhood of Truxillo; squills are found on the sea-beach of Lagunetas; storax in the jurisdiction of Coro; cassia in almost every part of the country; gayac on the coast; aloes are raised in Carora; a species of quinquina is obtained on the mountains; in short, the pharmacopœia of both the continents might be supplied from the vegetable stores of the Caraccas. In this enumeration of the native productions of this genial soil, we must not omit the vanilla, produced from a creeping plant, which, like the ivy or wild vine, entwines around trees. This plant, which requires uncultivated and moist ground covered with large trees, grows in great plenty in the forests of St Philip and Truxillo, on the banks of the Tuy. It is worth about 100 francs a pound; and the province of Venezuela alone, might, with some attention, be made to produce 20,000 pounds weight of it in a year. To propagate this valuable plant, nothing more is necessary than to insert some cuttings in the earth near a tree; they soon take root, and entwine firmly around it. A surer method to prevent the decay of the plant, is to graft the cuttings in the tree itself, about twenty inches above the ground. In the same list with vanilla may be placed wild cochineal, which grows in great quantities in the departments of Coro, Carora, and Truxillo. To be enabled to form a proper estimate of its value, the reader may consult a memoir lately published at Paris by M. Bruley, an intelligent and ingenious planter in Caraccas.

Nor does the animal kingdom, in this luxuriant country, yield to the vegetable in profusion and value. Within the captain-generalship of Caraccas, 200,000 horned cattle, 180,000 horses, and 90,000 mules, roam over the plains and vallies. Sheep are innumerable; and deer abound, particularly in Coro, Carora, and Tocuyo. In short, the account which M. Depons, after a long residence in this country, has given of its fertility and productions, amply warrants his assertion, that there are few countries to which Nature has been more lavish of her favours.

The fertility, as well as the beauty of these delightful regions, depends, perhaps, in no inconsiderable degree, on the number of fine rivers which pour down in all directions from the mountains. Not a valley is without its river, which, if not always large enough to be navigable, is at least sufficient to irrigate plantations, and would afford wonderful facilities to many important branches of manufactures. Those which have their source in the chain of mountains, flowing from south to north, are discharged into the sea; while those which spring from the southern declivities of the same mountains, traverse, in a southern direction, the whole extent of the intermediate plains, till they resign their tributary streams to the majestic Oronoko. The former, strongly fenced in by their banks, and happily favoured in their progress by the declivity of their channels, seldom overflow, and when they do, their overflowings are not long or detrimental. The latter, flowing through smoother grounds, and in shallower beds, mingle their waters during a great part of the year, and lose all appearance of rivers in the general inundation. All these rivers dwindle into insignificance when compared with the Oronoko, which, with the exception perhaps of the Amazons, is the largest river in the world. The particular description of this mighty river, with its tributaries, we must reserve for a future occasion, and shall, in the mean time, content ourselves with enumerating a few of those streams, which Depons has thought worthy of a particular description.

At sixteen leagues west from Cora is the river GUIGUES, navigable for canoes and sloops for six miles from its mouth. Twenty-five leagues to the east of Guigues, the river TOCUYO discharges itself into the sea. Its source is about fifteen leagues south of Carora, upwards of sixty leagues from the coast, and it is navigable as far as Hanagua, about forty leagues from its mouth. Its vicinity furnishes abundance of timber fit for every kind of building; and it flows through a fertile, but neglected country. Ten leagues to windward of the Tocuyo is the mouth of the AROA, of which the navigation is neither easy nor beneficial, though its course be upwards of forty leagues. Reascending along the coast, we come to the mouth of the YARACUY, three leagues distant from that of the Aroa. It has a course of forty leagues, but does not become navigable till within two leagues east of St Philip. From that point it is very useful for the conveyance of the produce raised in the valleys of St Philip, and the plains of Barquisimeto, which is sent by sea to Porto Bello, the nearest port. There is no river of importance between the Yaracuy and the TUY, which falls into the ocean thirty leagues east of the port of Guayra. The source of this river is in the mountains of San Pedro, ten leagues from Caraccas. After flowing through several extensive and fertile vallies, it is augmented by the junction of the Gnayra, and being thus rendered navigable, serves for the transportation of the produce with which these vallies abound, particularly cacao, which is there of the finest quality. No river to windward of the Tuy fixes the traveller's attention till he reaches UNARA, the line of division between the governments of Caraccas and Cumana. It pursues a northerly course for about thirty leagues, and is navigable about six leagues from the sea. All that deserves to be mentioned of the Neveri and the Manzanares, is, that the one is seventeen leagues, and the other twenty-seven east of the Unara; the former is too rapid and powerful to be navigated far, the other is too small to admit even small vessels more than a mile from its mouth. The latter stream washes the city of Cumana, to which, however, it is of little consequence. After passing Cumana, we meet the Gulf of Cariaco, which receives, besides several other streams, a river of the same name. This river passes by the city of Cariaco, about two leagues from the gulf, and is only thus far navigable, nor always even so far: for as it receives a considerable quantity of rain water, in dry weather it becomes shallow, and, in rainy weather, is subject to inundations, which are extremely inconvenient to the city. A tradition prevails among the Guayqueris Indians, that the Gulf of Cariaco was formed by an earthquake.

On all the northern coast, as far as the Cape of Paria, which, with the Isles of the Dragons, forms the great entrance of the Gulf of Paria, not a single navigable river is to be found. Of those which discharge themselves into the Gulf, the most considerable is the Guarapiche. This river, rising in the eastern declivity of Mount Brigantin, is swelled by many streams of considerable magnitude, so that it rolls towards the Gulf with all the majesty of a river of the first rank. To vessels of ordinary size, it is navigable as far as the Fork of Fantarma. Beyond that, the navigation is impeded, not so much by the shallowness of the river, as by the mangroves and trees which are thrown into it by the wind, or deposited by the currents.

These rivers are joined by an infinite number of smaller streams, yet they water only the high or northern part of the provinces of Venezuela and Cumana, and do not amount to the twentieth part of the rivers which proceed directly to the sea. The southern, or low part of Venezuela, is intersected by others which flow from north to south, till they discharge themselves into the great Oronoko. Of these, the most considerable are the Mamo, the Pariagoin and Pao, the Chivata and Zoa, the Cachimamo, the Aracay, the Manapira and Espino. In this enumeration, however, the first place must be given to the Apura. After receiving the waters of innumerable tributary streams, which form altogether the figure of a fan, occupying a space of upwards of thirty leagues, this river discharges its mighty flood by several channels into the Oronoko. Most of these rivers are navigable for forty or fifty leagues, affording the most animating anticipation of the future prosperity of the country through which they flow, when its inhabitants, more enlightened and industrious, shall have learned to appreciate and to improve the advantages which nature so profusely bestows.

The only lakes in Caraccas which are worthy of description are the lakes of Maracaïbo and Valencia. The lake of Maracaïbo is nearly in the form of a decanter, lying from north to south, with its neck communicating with the sea. Its length is about fifty leagues; its greatest breadth, thirty; and its circumference, upwards of a hundred and fifty. It is navigable to vessels of the greatest burden; but the entrance to it is considerably obstructed by a bar. When strong breezes prevail, its waves are so violently agitated as to overwhelm the canoes and small craft; but it is seldom visited by hurricanes. Its water is fresh; but when a gale blows strongly from the sea, it acquires a brackish taste from its mixture with the waves. In this lake the tide is more perceptible than on its neighbouring coasts. It abounds with all the different species of fish which are found in the rivers of South America: the tortoise alone forms a singular exception. The shores of the Maracaïbo are so sterile and noxious, as to discourage culture and population; insomuch, that the Indians preferred dwelling in huts, erected by a particular construction on the lake itself. In a place called Mena, to the north-east of the lake, in the most barren part of its borders, there is an inexhaustible mine of mineral pitch, the true natural pessaphalte, which, when mixed with suet, is used for graving vessels. The vapours exhaled from this mine are so inflammable, that during night phosphoric fires are continually seen, in their appearance resembling lightning. They serve as a light-house and compass to the Spaniards and Indians who navigate the lake, and who have no other object for observation but the sun by day, and these fires at night.

The lake of Valencia, though not so extensive as that of Maracaïbo, is much more interesting, both from its beauty and utility. It is of an oblong form, about thirteen leagues and a half in length, and its greatest breadth is four. Though twenty rivers discharge themselves into this lake, it has no visible outlet; yet neither its depth nor its extent appear to increase. To account for this singular circumstance, it has been supposed that there must be at the bottom of the lake a subterraneous channel, through which its waters are continually discharged; and in support of this theory it is observed, that boats sail with rapidity from the borders to the centre, where some dangers are encountered, but return to the borders with more difficulty. Nothing can be more magnificent and charming than the scenery round the lake of Valencia. The rich and beautiful valley in which it is situated, surrounded with mountains, except on the west, and the numerous islands scattered over its bosom, give it a strong resemblance to Loch Lomond, the most interesting of our Scottish lakes. The unfading verdure which adorns its banks, the endless variety of birds which sport in the neighbouring woods, vying with each other in the beauty of their plumage and the melody of their notes, and the fine plantations which extend from it in all directions, fill the heart of the spectator with a kind of rapture, which only the magnificence of nature can impart. Mr Semple saw on this lake the first sail which had ever been spread here, and naturally hailed it as the germ of future improvement.

On the northern coast of this country, from Cape de la Vela to Cape Paria, the tides are so irregular and imperceptible as to be entirely overlooked in nautical reckonings and calculations; whilst on the eastern coast, from Cape Paria to Dutch Guiana, they are so powerful as to command the anxious observation of all navigators who frequent those latitudes. The bearings of the coasts are the obvious cause of that remarkable difference. The winds are much more regular on the coasts, where nothing deranges their natural direction, than in the interior of the country, where they are subject to local influence. The trade wind, which prevails at sea in these latitudes, is likewise the common breeze on the coasts; with this difference, that at sea it is constant, but on the coasts it blows only from nine or ten o'clock in the morning till the evening. It blows from north-east by east; and is succeeded every night by an opposite wind, which is called the land-breeze. But this periodical succession, though general, is not without exceptions.

Pursuing the same course which we observed in our enumeration of the rivers, we come first to the port of PORTETA, about six leagues east of Cape de la Vela. This port admits only small vessels: but in the harbour of BAYAHONDA, four leagues farther to the windward, vessels of the largest size can anchor without being exposed to the smallest danger from the winds. Both these ports are in possession of the Indians, who derive from a pearl fishery in the road of Bayahonda the only article they have to barter with the Dutch and English. As we proceed along the coast to the eastward, we come next to the port of MARACAIBO, which, though in itself an excellent harbour, is rendered almost inaccessible by a bar of quick sand at its entrance, which is never covered with water beyond the depth of ten or twelve feet. Proceeding in the same direction, we come to CORO, whose port lies open from north to north-east. In this port the water continues to deepen as we approach the shore; but neither its accommodations, nor its commodities, are such as to render it a place of great resort. After leaving Coro, we meet with nothing that deserves the name of a harbour till we come to PORTO CABELLO, better known by the name of Porto Bello, which, for space, beauty, convenience, and safety, is by far the finest harbour on the whole coast of America. The whole of the Spanish navy might ride here without confusion; and the high lands which encompass it are so happily disposed, as to shelter it from the fury of any wind that blows. In the unruffled tranquillity of its surface, it resembles a pond, rather than a port upon those tropical seas, which are always agitated with more or less violence. PORTO CABELLO, the name given to it by the Spaniards, imports, that a vessel at anchor is more effectually secured here by a single rope, than elsewhere by the strongest cables. Its anchorage, which owes nothing to art, is so commodious, that the largest ships may lie along side of the wharf, and load and unload without the assistance of lighters. Three leagues to windward of this port is the bay of TURIAMO, which extends one league from north to south, but which, having no shelter from the north wind, is seldom visited by merchants, to whom the commodities of the adjacent countries hold out no temptations. The same remark is applicable to the bays of Patanemo, Borburata, and Sienega. Having passed these, we find ourselves next in the bay of OCUMARA, five leagues east of Porto Bello. This is a commodious and well sheltered harbour, defended on the east by a battery mounting eight pieces of cannon of the calibre of 8 or 12. At the distance of one league from the port is the village of Ocumara, watered by a river of the same name, which discharges itself into the bay, at the bottom of the port. The next port of any consequence which we meet with is that of GUAYRA, whose road is always so open to the breeze, that the sea is kept there in a state of continual agitation; and the violence of the winds frequently occasions damage to the ships which ride at anchor. The surge is very strong: and acting at the bottom, as well as on the surface of the water, keeps the sand in constant agitation, and deposits it in such quantities upon the anchors, that before they have been fixed for a month it is impossible to hoist them. To avoid the certain loss of their cables, every vessel is obliged to hoist anchor once in eight days. The depth of water does not exceed eight fathoms at the distance of a quarter of a league from the beach; and to complete the catalogue of its inconveniences, that species of worms, called tarets, which is so destructive to shipping, commits greater ravages here than in any port of the Caraccas. Yet in spite of all these unfavourable circumstances, the harbour of Guayra is more frequented than any other upon the coast. Between Guayra and Cape Codera, the distance is twenty-five leagues. The coast then takes a direction to the south-east, and conducts us to the lake of TACARIGUA, about thirteen leagues and a half distance from the Cape. In its form this lake exactly resembles a bay, a name which it would certainly have obtained, were it not for a bar of quicksand, which frequently cuts off its communication with the sea. Its form is circular; and from the sea on the north-east to its deepest recess on the south-east, it measures about seven leagues. The next port we meet with is BARCELONA, which is so shallow as to be incapable of admitting vessels of any considerable size, and affords no shelter but against the breeze. At the distance of one league to the north, however, the island of Borracha presents, on its south side, a safe harbour for ships of any magnitude. From Barcelona the coast runs to the north-east as far as Cumana, at the distance of two leagues. The intermediate space is filled with a chain of islands not far separated from the coast. Some of these are provided with bays and harbours, none of which, however, are of such importance as to merit particular notice. The port of CUMANA is well sheltered against the inclemency of the weather; but we forbear giving any particular description of it, till we come to speak of the government and town of the same name. To the east of Cumana, at a considerable distance, is the GULF of CARIACO, formed by a part of the coast of Cumana, the point of Araya, and the Barrigon. This gulf extends ten leagues from east to west, and is from three to four leagues broad. Towards the centre its depth is from 80 to 100 fathoms. Protected by the surrounding mountains from every wind, except the trade wind, its surface is in general as smooth as a lake: to that wind, however, it is entirely exposed, and its waters of course are agitated in proportion to the strength of the breeze. In this gulf, the lake of Eveco, the Gurintar, and Juanantar, are three places very convenient for loading. The point of ARAYA, lying east from the mouth of the river of that name, is rendered dangerous by its lowness, and by a sand bank, on the north-east, almost on a level with the surface, which advances two leagues into the sea. To this point, however, the attention of those who arrive from Europe must be directed, if they wish to make an easy entrance to the port of Cumana. For that purpose it is absolutely necessary to bear off from the north-east and south-west till they have doubled the point; after which they may coast along the shore for half a league. Advancing still to the east, we arrive at a large gulf, which the Spaniards call GOLFO TRISTE, but which is known to the French and English by the name of the GULF of PARIA. On the west of this gulf is that part of Terra Firma, called Paria, and on the east the isle of Trinidad. From these two lands on the north, two points jut out, between which lie two islands, with regard to these two points nearly east and west. These islands almost close the gulf on the north, leaving, however, between them, a space in which are four openings called the mouths of the Dragon, by which the superfluous waters of the gulf are discharged. The largest of these openings, being two leagues broad, lies on the west, between Point Paria and the island of Chacachacares. In this inlet to the gulf there is nothing dangerous, except a rock which just emerges from the surface at two cables length from the island of Chacachacares. Between this island and that of Navios is a second and smaller mouth, called the Vessels. Its channel, lying from north to south-east, renders it very good for the going out, but very bad for the entrance of ships. A third mouth, called the mouth of Huevos, (Egg's mouth,) is formed by the isle of Navios on the west, and that of Monas on the east. Lying in a direction from north, north-east, to south, south-east, it is much more convenient for entering than going out. The fourth mouth is between Trinidad, and the point that is most to the west south-west of that island. It is called the mouth de Los Monos, (Monkey's Mouth,) probably because it is rendered narrower and more difficult by a rock, which, from its position in the centre, occasions a continual commotion, while, at the same time, the land of Trinidad, by excluding the winds, occasions a calm which is but rarely interrupted by momentary gusts. This gulf is twenty-five leagues from east to west, and fifteen from north to south. In all that extent the anchorage is good, but the depth varies from eight to thirty fathoms: upon the coast of Paria, the soundings are much less. This gulf is in fact a real port, which, in extent and excellence, is scarcely surpassed by the finest in the world. Its bottom is muddy, except on the coast of Terra Firma, where there are shoals and banks of sand. Though the waters of this gulf have been said by some authors to be fresh, they are in reality as salt as those of the sea. A considerable volume of water is poured into it on the south south-west, by different mouths of the Oronoko, with a velocity which greatly incommodes vessels steering that way on their passage. Depons thinks it probable that a part of those waters have, in the progress of ages, detached from Terra Firma what is at present called Trinidad, and that their ravages will not cease till they have opened the mouths of the Dragon, and thrown themselves into the ocean. The currents, which are always carried into the sea by the channels of these mouths, render it impossible to enter, particularly by the small ones, unless the winds be highly favourable. Nor is it less difficult to enter on the south than it is on the north. It cannot be attempted with safety unless the wind be from the south-east, and then it is necessary to coast it to the south of the island of Trinidad as far as point Hicacos, which must be approached within two cables length, in order to pass between that point and a shoal in the middle of the channel, formed by the same point and the small island of Soldado. There are several ports and roads along the coast of Paria which greatly facilitate the communication with Trinidad.

After this detailed account of the climate, the natural history, and physical aspect of this country, it becomes an interesting inquiry, what improvement do the inhabitants make of the advantages which nature has so liberally afforded? Few parts of Spanish America are under better cultivation than Caraccas, because when its mines disappointed the expectations of its conquerors, they were compelled to depend on the productions of the soil for the riches which its bowels denied. The luxuriant vegetation of its vallies might well inspire the most sanguine hopes; and, in the hands of a people trained to habits of regular industry, would soon have become a source of ampler and more substantial wealth than could ever be derived from the mines of Mexico and Peru. But the Spaniards, intent as they were on riches, were too indolent, or too unskilful to reap the full benefit of their situation; and though agriculture flourishes more in Caraccas than in any other of the Spanish provinces, it is at this day so imperfect as scarcely to raise the one-thousandth part of the production which this favoured country might be easily made to yield.

Cacao, an indigenous production of this part of America, naturally attracted their first attention. It was soon adopted as one of their most favourite aliments; and in the mother country the relish for chocolate became so strong, that it was regarded as even more indispensable than bread. Plantations of cacao were accordingly multiplied in Caraccas, and the congenial soil, answering the fondest wishes of the planters, yielded crops of this valuable fruit no less excellent than abundant. To the merchant the best recommendation of cacao is, that it comes from Caraccas; but even there its qualities vary in different provinces. The cacao of Oriuco is superior to that of other places, and weighs twenty per cent. more than an equal quantity of any other. Next to that is the cacao of the coast, which is preferred to that of the interior. The plantations of cacao are all either to the north of the chain of mountains which coast the sea, or in the interior country. Two principal crops of them are gathered in a year; one about St John's day, the other towards the end of December. The cacao ripens, however, and is gathered during the whole year. But in all seasons the planters of Caraccas endeavour, as far as possible, to collect their crops only at the wane of the moon, imagining that the nuts are then more solid, and less liable to spoil. Some of them, however, ridicule this practice, as no less inconvenient than absurd; because, if the harvest continue only during the fifteen days of the moon's decline, much of the ripe fruit must be left rotting on the tree, and a great loss would thus be incurred by suspending the harvest during the moon's increase. More attention is paid to the culture and preparation of cacao in the eastern part of Terra Firma, than in any other part of the world; and to this attention, as much perhaps as to the excellence of the soil, must we ascribe that superiority which the cacao raised here possesses over that of every other country.

Till the year 1744, cacao was the only article of cultivation in Caraccas. At that time two individuals introduced the culture of indigo, which, in spite of strong prejudices against it, succeeded so well, that all new plantations were now prepared for indigo. The vallies of Aragoa, where it was first cultivated, exhibited an unexampled and astonishing rapidity of increase. Over immense plains, lying till then in a state of nature, plantations of indigo rose as if by enchantment. And the concourse of cultivators gave rise to many new villages, and restored others from a state of ruin to the elegance and importance of cities. The culture of indigo has extended from the vallies of Aragoa to the south-west as far as Varinas. None of it appears on the coast, nor eastward of the town of Caraccas to the gulf of Paria, nor southward to the Oronoko. To enter into a detail of the process by which indigo is prepared, would be here out of place. We may only observe, that the inhabitants of Terra Firma, instead of suspending it in sacks, after fermentation, dry it under sheds. This method, though tedious, is favourable to the quality of the indigo. It thus acquires greater hardness and lustre, and its weight, in proportion to bulk, is considerably more than that of indigo dried in the sun. In packing this commodity, likewise, the Spaniards have adopted a better method than that which is usually followed. Instead of putting it into barrels, they pack it in sacks of coarse linen, over which a calf's hide is so hermetically sewed as to be quite impenetrable. These packages, which are called ceroons, possess great advantages over barrels. They are more solid, more convenient for transportation, nor are they liable to any damage from the rough usage which they may encounter on their conveyance from the place of manufacture to any European port, or from the carelessness and unskilfulness of carriers in their subsequent circulation.

Cotton, though long known in Caraccas, was so much neglected, that, previous to the year 1782, a hundred plants formed about the proportion of the largest plantation. The success of the indigo plantations, affording a sufficient proof that the soil of that country was not adapted exclusively to the culture of cacao, at length induced some planters to pay attention to the cultivation of cotton; and their success was so flattering, that the cotton plant soon occupied a considerable portion of the vallies of Aragoa, Valencia, Araure, Barquisimeto, Varinas, Cumana, and several other places in the provinces of Caraccas. As the cotton is destroyed by frequent or heavy rains, the coast from Cape de la Vela to Cape Paria, which attracts the clouds, is improper for its culture, and, of course, no cotton plantations are there to be found. In the dependencies of Caraccas, cotton is planted only in the months of May and June; because, as the plants blossom always in November, those planted in July and August would be surprised by the blossoming season before they had reached their natural growth, and had acquired the consistency necessary to perfect fructification. Contrary to the practice of the French colonies, who plant their cotton trees in a quincunx form, the Spaniards of Caraccas plant on straight lines, drawn with a cord, and separated by a space of seven or eight feet. The holes to receive the seed are four feet distant from one another, and into each are thrown five or six grains, not more than the half of which generally rise. The worms, so destructive to the cotton-plant in other countries, never attacked it in the vallies of Aragoa until the year 1802, and their appearance was probably occasioned by the abundant rains which fell in the four preceding years. Though less skilful, perhaps, in the culture and preparation of their cotton than the English, French, and Dutch, the Spaniards at least pack it more conveniently. Instead of stuffing it into unwieldy bales of three hundred weight, as is usually done, they make small packages of a quintal, which, by the aid of presses, are reduced to so small a compass, that each package is not more than fifteen inches in length, nor from ten to twelve in breadth. Each package is in general covered with an ox's hide, in such a manner as to protect the cotton from all damage.

Coffee, which, in the colonies of every other nation, had, for more than half a century, formed an important branch of commerce, was cultivated in the Transatlantic dominions of Spain merely as an article of domestic consumption, till Don Barthelemy Blandin, in 1784, devoted to its exclusive cultivation a property which he possessed in the valley of Chacao, within one league of the town of Caraccas. The valley of Aragoa, where all the enterprise and activity of the Spaniards seems to be concentrated, was the first to adopt this new branch of cultivation; and so rapid and general was the influence of its example, that not only all the new plantations, commenced since 1796, are in coffee, but many planters have abandoned cacao and indigo to make way for its cultivation. Still, however, the culture of coffee is so far from having attained the increase of which it is susceptible in this extensive and fertile country, that the quantity produced, independent of what is used for domestic consumption, does not exceed 1,000,000 pounds. Less attention is paid by the Spaniards to their coffee in the various stages of its growth, as well as in its preparation, than its importance demands. The weeding of it, in particular, is so much neglected, that the young plants have to struggle continually against weeds, which not only impede their growth, but threaten their existence. In gathering the crop they are equally careless. The cherry which has just begun to redden, as well as that which is thoroughly red, is indiscriminately gathered, and delivered to the process of fermentation, which is itself defective.

In all the other European colonies situated between the tropics, sugar is the prime article of commercial produce. In Caraccas, it enjoys only a secondary rank; for, though it is raised in considerable quantities for home consumption, scarcely any of it is exported. The quantities of sugar which the Spaniards devour, furnish a sufficient explanation of the deficiency of this branch of their commerce. The inhabitants of Caraccas, without distinction of condition, fortune, or colour, make sugar the principal article of their food. *Guarapo*, an intoxicating beverage, of which all classes, particularly those of inferior rank, are passionately fond, is produced by the fermentation of sugar in water. In the banquets of the rich, confectionary holds the most distinguished place. Their deserts sometimes consist of two or three hundred dishes of sugars, tastefully arranged and moulded into every shape that can be imagined, to excite the admiration of the company. In a word, there is not a single negro, whether freeman or slave, whose meal does not consist of a little cacao boiled in a great quantity of water, and a large lump of coarse sugar, which he eats like bread. It can scarcely be wondered, then, that sugar should make such a trifling figure among the exports of the Caraccas. The sugar plantations are generally in the vicinities of towns, because there the sale is readiest, and the greatest facilities are afforded to cultivation. The planters of Terra Firma are very skilful in distinguishing the qualities of soil which sugar requires, of which the excellence of their sugar affords an indisputable proof. Before the year 1796, all their plantations contained the same cane that is raised in the other colonies. At that time, the cane of Otaheite was brought from Trinidad, and its advantages seemed so great that it was generally adopted. Notwithstanding the excellence of soil in Caraccas, its sugar, from want of due care and skill in the different stages of its preparation, is much inferior in crystallization and whiteness to that of the other colonies. The alkali which they employ consists chiefly of ashes, which, besides giving the sugar a brown tinge, prevents it from acquiring the proper consistence. Their method of drying the sugar appears likewise very exceptionable. They spread it upon an elevated platform, covered by a grooved roof. In fair weather, they shove aside this roof, that the sugar may be exposed to the rays of the sun. The sugar, however, has time to regain, during the rains, or from the dampness of the night, the humidity which the sun had drawn off; and the transitions from dry to damp, and from damp to dry, necessarily destroy the grain of the sugar, and prevents it from being sufficiently consolidated to render it durable. Another cause of the general inferiority of sugar in Caraccas is, that the planters find their interest in selling as sugar a mass composed of all the molasses, and of eight tenths of the mucilage, which are justly regarded in the other colonies as heterogeneous particles. The poor, who subsist principally on this impure compound, procure it at a small expence, and habit makes them prefer it to clayed sugar. For the fabrication of the *guarapo*, too, this compound is much preferable to clayed sugar, because it possesses, in a superior degree, the principles of fermentation. In a short time, the manufacture of sugar will probably be much improved in the provinces of Caraccas; for the valuable work of Dutrone on the history of the cane, and on the means of obtaining sugar in greater quantity, and of better quality, than by the ordinary process, is in the hands of several planters, who are prevented from applying its principles only by the difficulty of procuring the proper utensils.

The cultivation of tobacco was at first free; but the necessities of the state, and the expences of the government of Caraccas and its dependencies, at length induced the king to reserve to himself the exclusive privilege of planting and selling it here, as he had done long before in the kingdoms of Mexico, Peru, and Santa Fe. A cedule, executed in 1779, severely prohibited all persons from sowing tobacco, and fixed upon the places which were considered the most suitable in the different provinces for cultivating and preparing tobacco on the king's account. In each of these places administrations were established, all subject to a director general of tobacco, residing at Caraccas, with a salary of 4000 dollars. The persons entrusted with these administrations, distribute allotments of the land appropriated to the culture of tobacco to such as apply for them. The quantity allotted is proportioned to the abilities of the grantee, and to the number of cultivators which he engages to employ. Advances of money are even made to him, which are deducted from the amount of the first tobacco he delivers to the exchequer. An express injunction is laid upon him, to sow all the land given him with tobacco alone, and to deliver to the king's officers all the tobacco which he raises, without retaining a single leaf; and he is paid according to the quality. The Spaniards of Caraccas give their tobacco two kinds of preparation: one of which they term *cura seca*, or the dry preparation; and the other *cura negra*, or black preparation. The only distinction of the *cura negra* consists in the degree of fermentation which it receives. The object of this preparation is to obtain from it a juice highly esteemed in the country. For this purpose it undergoes an operation which blackens it, and from that circumstance it derives its name. Both the *cura seca* and *cura negra* are divided into three qualities, the prices of which, paid to the cultivators by the king, are very different. In classing them, great abuses take place, which the law has never been able to prevent. According to a wise, but ineffectual regulation, passed on the 2d of June 1787, the delivery, reception, weight, and qualities of the tobacco, must be determined according to certain forms, in presence of the factor, book-keeper, administrator of the magazines, the visitor or inspector, the cultivator, and the commissary-general of the plantations. The tobacco is classed by the inspector, who is not to be impeded in the discharge of his duty. The cultivator, if dissatisfied, may appeal to the assistants, whose unanimous voice can change the classification; if they are divided in opinion, they refer the decision to persons of experience. Though the tobacco may not have all the qualities requisite to preserve it for a length of time, it is received according to its class and value, provided its corruption does not take place within five or six months. While the tobacco is weighed in presence of the above-mentioned company, the steel-yard is held by one of the guards nominated by the administration. Two invoices are made of it, and signed by all the assistants. One of them remains at the factory, the other is consigned to the commissary-general of the plantations. The cultivator is paid for his tobacco at the following rates: For a quintal of the *cura negra*, first quality, eleven dollars; second quality, ten; third quality, seven. For a quintal of the *cura seca*, first quality, ten dollars; second quality, eight; third quality, three.

A stranger, in travelling through this country, the most lovely and luxuriant perhaps in the world, is astonished to find its plantations so trifling and unproductive. A planter is considered rich, whose annual income amounts to 4000 or 5000 dollars; nor are there twenty plantations within the captain-generalship of Caraccas which yield a greater revenue. This is not owing to an over minute division of property; but it is rare to see one-tenth of a plantation cultivated. It is a fact, extremely disgraceful to the government of Caraccas, or to the inactivity of its inhabitants, that, in this wide and fertile district, there is raised not one-tenth part of the produce which the industry of the French extorts from St Domingo, a country 200 times less spacious, incomparably less watered and less fertile, and with not more than one-half of the white population.

Five causes are assigned by Depons for this backward state of cultivation. The first is, the number of mortgages with which every estate in Caraccas is more or less burdened. As the Spaniards never alienate any property, however poor they may be in reality, they must still maintain the appearance of wealth. When in want of money, they borrow it at an interest of 5 *per cent.* on their landed possessions: loans, which are the more easy, because the low state of commerce prevents money from rising to a high rate.

A still more serious evil arises from the pious legacies and prebends with which many estates are encumbered. These legacies, augmenting from generation to generation, cannot be bought up by payment of the capital, but keep the planter under an obligation to pay regular interest, and thus deprive him of the means of increasing his productions. It would be infinitely more conducive to the public prosperity, if all these pious donations were discharged in full, even though it should be necessary to sell all or part of the fast property, rather than suffer them to accumulate on the possessions, the annual interests of which consume their revenues, and paralyse the industry of the most active proprietors. Adverse seasons, which destroy two or three crops successively, ruin for ever a planter, however industrious he may be, who is burdened with mortgages. The debt is continually augmented by expences; chagrin overcomes his activity; his property is sequestrated, and passes with the same charges to another planter, who is threatened with the same fate.

A third obstacle to culture, more pernicious, if possible, in its operation than the two former, is the pride of the planters, who disdain to take any charge of their plantations, which they entrust wholly to overseers. To this is added their extravagant mode of living. Every proprietor has his residence in a city, where his retinue of servants and household expences are regulated according to the revenue of the plantation, which is generally calculated on the proceeds of the most fertile and prosperous year. The expenditures, of course, almost invariably exceed the receipts; and the planter accuses the seasons or the laws for the difficulties in which he is involved by his own indiscretion.

The ambition of the Spanish Americans for public employments, is another circumstance which operates nearly in the same way as their extravagance to the prejudice of agriculture. The prospect of unbounded wealth from a large and rich plantation could not induce a Spaniard to relinquish his desire of a military rank, a place in the finances, a judiciary office, or the cross of an order. To secure these grand objects, every planter of consideration has his agent at Madrid, who collects for him all the necessary information, and takes the proper measures for obtaining any place or appointment which he thinks will suit the inclination of his client. Before this be done, however, he must be handsomely paid; and every Spaniard in America considers a remittance of money to Madrid as a preliminary essential to the success of his solicitation. Many plantations are mortgaged, in order to raise these necessary remittances; the source of landed wealth is thus dried up; and, at any rate, men aspiring to public distinctions, cannot stoop to the concerns of an estate, which, whatever riches it might yield, can confer no splendid honour.

The character of the overseers is, in general, such as might be expected amidst this universal mismanagement. Without honour, emulation, or intelligence, they are indebted, even for the indifferent crops which they raise, to a fertility which seems to defy their ignorance and carelessness. The few plantations which prosper, are conducted by proprietors themselves, ambitious to increase their revenues, and proud of the name of cultivators. Those which decline, belong invariably to persons who only visit them as strangers, and who, in the indulgence of extravagance and dissipation, or in the pursuit of favours and employs, disdain the low cares of a planter, and would think themselves insulted by being supposed to know any thing of the condition of their own estates.

The last cause assigned by Depons for the decline of culture, is the want of a sufficient number of negroes. Though the Spaniards were never allowed the direct importation of negroes from Africa, they were permitted to purchase them in the Antilles, to pay for them in the produce of the country, excepting cacao, and to resell them in Terra Firma. But the revolt of the negroes in St Domingo, in 1791, spread such an universal alarm, that for twelve years, not a single negro arrived in Caraccas. The labours of the country of necessity languished, its productions were diminished, and a new supply of labourers became indispensably requisite. Caution, however, was necessary, lest negroes should be imported from the French colonies, who would bring along with them the seeds of revolt. With a view of supplying the provinces, permission was given by the king to Edward Barry & Co. for the introduction of 4000 negroes; but the grantee's death arrested the operation, and only particular permissions were given. Two merchants obtained, in May 1804, two of these permissions, each amounting to fifteen hundred negroes. By this regulation, those who introduce black slaves are known, and can be made answerable for any irregularity in their behaviour. Still, however, these supplies are very inadequate to a country which does not contain the 20th part of the population necessary to cultivate it; where the births of slaves are far less numerous than the vacancies made by their deaths, and where the benevolence and piety of the masters annually transfer a considerable number of individuals from the class of slaves to that of freedmen. We can hardly agree with Depons with regard to the strong necessity of facilitating the introduction of negroes; but we cordially agree with him in considering the employment of the idle hands of free men of colour, and of the Indians of *doctrinaries* and missions, as a measure of the last importance to the agricultural prosperity of Caraccas. The Canary Islands, whose youth have a decided predilection for America, might also furnish a considerable number of active and useful labourers; and were the salaries of workmen punctually paid, and their emulation excited, idleness would give place to activity, and agricultural operations would go on with spirit and effect. Mr Semple, who visited Caraccas little more than a year ago, informs us, that charming plantations extend in all directions from the town of Maracai, and have an air of prosperity and activity which he was at a loss to account for, till he learned, that on these plantations work was chiefly performed by free labourers, and that the use of slaves for the great purposes of society was, comparatively speaking, little known.

From this view of the state of agriculture in Caraccas, it follows almost as a corollary, that its commerce must be in a very languishing condition. A nation, which, even at this day, estimates the value of its colonies by the quantities of gold and silver which they furnish, cannot be supposed to derive much advantage from the more substantial riches of their soil, or to be aware of the resources, almost inexhaustible, that a well-regulated commerce would open in a country, which, in fertility, in climate, in the abundance and value of its vegetable productions, has no parallel in any quarter of the globe. So little were the Spaniands capable of appreciating the value of their possessions in Terra Firma, that, for upwards of a century after the discovery of Caraccas, it furnished to the parent country no article of commercial produce: one vessel alone arrived annually from Spain, not to receive any valuable cargo, but to convey the necessaries of life to a country capable of maintaining the whole of Europe. It was not till the Dutch settlers in Curaçoa had commenced a traffic with the neighbouring continent, about the middle of the 17th century, that the inhabitants of Caraccas began to perceive the advantages of their situation; and the merchants of Spain thought it an important favour, to have permission to send two trading vessels to Venezuela. The absurd policy of the court, whose permission to trade with its colonies, after being obtained with much difficulty and expence, was rendered of little value by the enormous duties imposed on every article of merchandise, deprived the Spaniards of all chance of successful competition with the traders from Holland, who could supply the same articles free of duties, and directly from the manufactories of Europe. The two Spanish vessels were compelled to sell their cargoes at a loss of sixty per cent.; and the other merchants of Spain, warned by their failure, left the Hollanders in the undisputed enjoyment of the trade to Caraccas. The remainder of the 17th century elapsed without the arrival of one vessel from Spain; and, during that interval, the inhabitants, animated by the advantages of their commerce with the Dutch, had so far enriched their country by cultivation, that the annual amount of cacao, in the province of Venezuela alone, exceeded sixty-five thousand quintals. The Spanish government, anxious to exclude foreigners from any participation of the riches of this flourishing province, established a severe inspection, for the purpose of preventing all communication with the Dutch; but, in spite of this expedient, not above one third of its produce found its way to Spain, or its possessions, while the residue went off in a contraband trade, which, as it was favoured by the situation of the country, and the interests of the people, no efforts of government could prevent. At length, some merchants of Biscay proposed to the king, in 1728, to destroy, at their own expence, the trade of foreigners with the province of Venezuela, on condition that they should be permitted to supply the country, and export its produce to the metropolis. To this proposal his majesty acceded, though not without imposing conditions, which seemed calculated to deprive the company of almost all the advantages which they expected from the grant. The justice, moderation, and activity of this company, while they conciliated the favour of the colonists, afforded complete satisfaction to the court, from which they obtained the privilege of an exclusive commerce. Though this privilege does not appear to have been abused, it excited in Venezuela a general dissatisfaction, which was ready to break out into rebellion, when an expedient was adopted to remove the suspicions, to which the hideous form of a monopoly had very naturally given rise. It was agreed, in 1750, that an assembly should be formed of an equal number of members of the company, and cultivators belonging to the country, in which the governor-general of the province of Venezuela should preside. By this assembly the price of cacao to the company was to be decided; no variation of which was, in any case to be permitted, without the formal assent of the assembly. Such of the planters as were not satisfied with the established price, were allowed to send a sixth part of their cacao to Spain, on their own account, and in the vessels of the company. Notwithstanding the restrictions with which this company was hampered, its success was so great, and its influence on the cultivation of the province so beneficial, that, in less than thirty years, the quantity of cacao exported annually rose from 65,000 quintals to 110,659; and Venezuela acquired an air of prosperity unknown in any other Spanish colony. In time, however, the company so far forgot the principles of honour and moderation, as to employ its wealth in tampering with the assembly, destined to curb its cupidity, and even to engage with the Dutch in the contraband trade, which it had solemnly pledged itself to destroy. Such irregularities necessarily occasioned its dissolution; and by a decree of the Spanish government, of the 12th October 1778, the commerce with Caraccas was declared free to all natives of Spain, and, in effect, to all the Spanish colonies. The import and export duties underwent at the same time such a reform, as seemed calculated to combine the advantages accruing to the revenue from the proceeds of the custom-house, with the necessary protection to national industry and commercial enterprize, and the supply of Spanish America. Articles exported to the colonies are divided into three classes. The *first class* includes articles of the growth or manufacture of Spain, which are called *free articles*, because the duties to which they are subjected are comparatively trifling, though they exceed nine and a half per cent., both on their leaving Spain, and on their entry into America. The *second class*, named articles of contribution, are those, which, though of foreign production, have received in Spain a degree of workmanship, sufficient to change or to improve their form. The duties on these articles amount to about twelve and a half per cent. The *third class* comprehends all articles imported from foreign countries to Spain, and ultimately sent to America. The duty on such articles, on their entry into Spain, is fifteen per cent.; on their departure for America, seven per cent.; at their arrival, seven per cent.; besides other moderate duties, which raise the price of all foreign merchandize, imported from the mother country, about forty-three per cent. With the exception of cacao, colonial productions pay but trifling duties on leaving America and on entering Spain, and are totally exempt from duty on their exportation for foreign markets. The trade to Caraccas is far from being lucrative to the Spanish merchants. Cargoes delivered in America acquire, by a common calculation, a value of thirty per cent. above their price in Spain; and a merchant thinks himself fortunate, when he can sell the whole of his commodities at thirty-three and a third per cent. above first cost, having thus a neat profit of only three and a third per cent. Even this profit, scanty as it is, may be regarded as in a great measure fictitious; for it is doubtful, if it cover the losses to which the merchant is exposed, by the credit which he is obliged to give.

In the year 1796, immediately before Spain declared war against Great Britain, the importations from Spain to Caraccas amounted, in value, to 3,118,811½ dollars, the importation duties on which were 281.328 dollars. The exports to Spain, in the same year, were estimated at 2,098,316 dollars, the duties on which amounted to 138,052 dollars. Since that period trade has rapidly declined, owing partly no doubt to the war, but much more to the indolence and pride of the inhabitants, among whom commerce is considered as degrading to people of rank; to the injudicious restrictions imposed by government; and to the carelessness of those employed by the court to detect and remedy abuses.

Almost the whole commerce of this country is now carried on by European Spaniards, chiefly Catalonians, and by Islenos, or islanders from the Canaries. A spirit of union, and a strong provincial dialect, binds the Catalonians together, and gives them a considerable advantage in all commercial transactions. When a cargo arrives, one or two Catalonians conclude the bargain, when all the rest, who have any interest in it, appear for their share in the division. The indolent natives, far from being jealous of this appropriation of their commerce by strangers, are accustomed to boast that their rich and abundant productions, while they exempt them from the necessity of going to Europe, draw Europeans to their country, and convert them into their servants. “In this manner,” says Mr Semple, “reason the Chinese, vain of their supposed superiority over all mankind. And in this manner might argue the savages of the South Seas, who behold Europeans visiting them, but who never visit Europe."

Though in Caraccas, as in all the provinces of Spanish America, the taxes are numerous and oppressive, the government establishment is so expensive, that, till a very recent period, the expenditure exceeded the revenue by at least two-thirds. While the receipts of the treasury continued thus insignificant, both the civil and military administration were concentrated in the person of the captain-general.

As the revenue became more considerable, the system of management was changed; and, in 1777, an *intendant* was placed at the head of the finances, whose authority extends over the whole district. In his own department, the intendant is totally uncontrouled. He has power to ordain any regulation which may seem necessary for the interior government of the finances, and nominates provisionally to every vacant office in the administration. In the different provinces, he has delegates or governors, who in their respective jurisdictions administer the public money, direct the ordinary expences, and determine provisionally on all difficulties arising within their limits, on the collection of duties. They can authorise no extraordinary expenditure, however, without the concurrence of the intendant; and to him, in case of any dispute about the collection of revenues, there always lies an appeal. To agriculture, commerce, and navigation, the intendant is bound to direct his principal care. With regard to agriculture, he can make no regulation, but only transmits to the king his observations on the measures most proper for its encouragement. In regard to commerce and navigation, he is under no such restraint. Without any responsibility, he may repress the abuses he perceives, or issue ordinances for improving their system. The office of the intendant continues five years, during which he enjoys the rank of a field-marshal. His annual salary is 9000 hard dollars, and his other emoluments amount to double that sum.

The business of the principal customhouses is conducted by a cashier or contador, and treasurer, who are royal officers, and whose duties are nearly the same. The accounts of the customhouses and receivers are subject to the controul and revision of a tribunal *de cuentas*, or of accounts, which is composed of two officers, called *contadores mayores*, or chief auditors. These contadores must verify all accounts before they can be sent to Spain: they regulate all questions of account, and enjoy their office during the same time as the intendant. From the decisions of the court of accounts and the intendant, an appeal lies to the supreme chamber of finance, of which the intendant is president. In description, this system of financial authorities appears abundantly simple; but, in reality, there is no part, even of the Spanish dominions, in which the persons employed in collecting taxes are, in proportion to the amount of the revenue, more numerous than in Caraccas.

Our limits do not allow us to give a detailed account of the different taxes levied in this government. We shall, therefore, content ourselves with giving, in the following table, a statement of the receipts and expenditures of the different provinces, for five years, commencing in 1793.

Years.	Net receipts of all the Taxes.	Expences of every kind.	Balance.	
	Hard dollars.	Hard dollars.	Favour Hd. dollars.	Against Hd. dollars.
1793	1,312,188$\frac{1}{4}$	1,303,583$\frac{3}{8}$		191,365$\frac{1}{8}$
1794	1,561,931	1,639,900		77,969
1795	1,443,056	1,549,874		106,817
1796	1,389,804	1,049,247	340,565	
1797	1,140,788	1,886,363		745,475

This statement does not comprise the sums arising from the culture and sale of tobacco, which belongs exclusively to the crown, because these sums are administered separately, and have their own peculiar bank and appropriation; nor the receipts from bulls, the power of distributing which was first granted by the Pope to the Spanish monarch, for the benefit of his subjects, who took arms against the infidels in the holy war. Though this war has long been at an end, the bulls still continue to arrive from his Holiness; and the blessings which they impart are considered too precious, and their advantage to the exchequer is too important, to allow them to be easily renounced. These bulls annually produce 26,000 hard dollars; and the exclusive sale of tobacco, deducting all charges, brings in 700,000 hard dollars a year.

The first settlements of the Spaniards in this part of Terra Firma, were completely similar, in their history, to their other settlements in America. To this, as to the other regions of the New World, they were at first impelled by their thirst for gold; and the provinces which now compose the captain-generalship of Caraccas, as they contained no mines which could be wrought to much advantage, were long neglected by the Spanish government. Before these mines could be explored, however, it was necessary that the original inhabitants of the country should be subdued. In this conquest the Spaniards had to encounter considerable difficulties. Many of their troops were cut off by sudden and unexpected onsets of the Indians; and they purchased, with no small loss of blood, a territory which they were soon inclined to abandon, as altogether unprofitable. In our account of the mines of this dependency, we have already mentioned the disasters to which the Spaniards were exposed from the Indians. They at length, however, succeeded in their total subjugation; and the same form of government was established here which had been framed for the other Spanish dominions in the western hemisphere.

All the Spanish provinces in America are governed by representatives of the king, some of whom, as the governors of Mexico and Peru, are named viceroys; and others, as the governor of Caraccas, have the appellation of captains-general. The power of this governor is supreme in military affairs in the province of Venezuela, and its dependencies, Maracaïbo, Varinas, Guiana, Cumana, and the island of Margaretta. He is likewise president of the royal audience, and of all the tribunals, excepting those which relate to the royal treasures and to commerce. Although in the capacity of captain-general he may form whatever regulations he pleases, without advice and without controul, he generally submits any case of importance to a *junta de guerra*, composed of the first military officers. He is exclusively charged with all political relations between the colonial government of foreign powers and his particular district. In civil matters, his jurisdiction is confined to the province of Venezuela. Maracaïbo, Margaretta, Cumana, and Guiana, have each a governor, who exercises the same civil powers in his own province that the governor of Caraccas enjoys in his. As the qualities of a good soldier are not always combined with the knowledge and habits essential to the proper administration of justice, the governor is obliged, in all judicial affairs, to have recourse to a counsellor at law, entitled his assistant, who records and signs the sentences. These sentences have no validity without the signature of the governor; and if they do not meet his approbation, he can pass the documents to another person, termed assistant *ad hoc*, who furnishes a new sentence. The governor may even give a decision contrary to the advice of these legal counsellors—a power which he never employs, however, except in cases where it appears necessary, and may be readily justified. Though president of the royal audience, he has no voice in its deliberations, or any influence, even by vote, on its decisions. That court, where he represents the majesty of his sovereign, is the only tribunal which is permitted to investigate his actions. Great as the power of the captain-general is, he is in general prevented from abusing it, by the responsibility which he incurs, and the certainty of being called to a rigid account for every act of his administration. His office terminates in seven years, and no sooner is his successor nominated, than a commissary is appointed to receive his resignation. This commissary immediately announces, in the most public manner, the time and place appointed for the examination of the transactions of the late governor; and all who have any complaints against him are invited to attend and substantiate their charges, that strict justice may be awarded. The results of these examinations are forwarded to the council of the Indies, who decide on them definitively.

The *Royal Audience* is a council, composed of a president, (the captain-general), a regent, three oidors, two fiscals, one for civil and criminal affairs, the other for the finances; a reporter, and an alguazil major. This audience is invested with a power of superintendance over all other constituted authorities, not even excepting the ecclesiastical tribunal. The captain-general is charged by the king to consult the audience on every extraordinary emergency; and they enjoy the very uncommon privilege of corresponding with his majesty without the knowledge of the governor.

The members of this audience are distinguished by the title of *highnesses;* and, according to a royal decree, the viceroys are commanded to treat them with all respect, as their brethren, and as magistrates whom the king honours with his confidence; to admit them immediately whenever they visit them, and listen to them as fathers, chiefs, protectors, and presidents.

The *Cabildos* are courts invested with the charge of police and of municipal affairs in the different towns, villages, and districts. They are composed in general of *alcades in ordinary*, or municipal officers, *regidors*, and a *syndic*. By the constitution of the cabildos of Caraccas, the governor is president of all the cabildos within his district. The alcades are elected every year, on the first of January. In places which have no cabildos, the police and administration of justice is committed to a *lieutenant of justice*, whose jurisdiction generally extends over three or four villages. For the exercise of his authority, which is almost unlimited, the lieutenant of justice is accountable only to the governor. His office continues for two years, but he may be re-elected.

The forms and proceedings of all these tribunals are complicated, tedious and expensive. No nation is so much addicted to litigation as the Spanish, both in Europe and America; hence the number of judges, advocates, attornies, notaries, scriveners, alguazils, and clerks, is quite incalculable, and the citizens are divided into two classes, one of which is duped and ruined by the chicanery of the other, which supports and enriches itself by the follies and misery of the simple and litigious.

There is perhaps no country where an invading army would meet with fewer obstacles than in Caraccas. Its sea-ports, indeed, are in general pretty well fortified, and might repel, with considerable success, an attack upon the single point in which they are situated. But their great distance from each other would render them totally useless for general defence. On the wide extent of shore, many places would be found of easy debarkation; and, with proper guides, a hostile army might, with the utmost facility, overrun a country abounding in every kind of provisions, while its protecting force, at the best but small, would be rendered still less efficient, by being distributed in a number of remote garrisons.

The defence of all the provinces included in the government of Caraccas is committed to the captain-general. The governors of particular provinces may adopt such provisional measures as exigencies require; but for these measures they are accountable to the captain-general, whose orders they must eventually execute. One great and obvious disadvantage attends this system. The immense distance by which the provinces are separated prevents the union of their forces, without much difficulty and delay; while the governors are often prevented from adopting the proper provisional measures, by the fear of giving offence to their superior. But were there nothing to prevent the united action of the whole military force of Caraccas, it would still be very inadequate to the defence of such an extensive and valuable country. The whole army consists of 13,136 men, who, before the present civil war, were distributed among the different provinces in the following proportions: In Caraccas and its environs, 918 troops of the line, 900 artillerymen, 1630 militia; in Valencia, 1530 militia; in the vallies of Aragoa, 1530 militia; in S. Carlos, 50 militia cavalry; in Cumana, 221 troops of the line, 450 artillerymen, 2245 militia; in Maracaïbo, 308 troops of the line, 100 artillerymen, 810 militia; in Guiana, 150 troops of the line, 100 artillerymen, 870 militia; in the Isle of Margaretta, 77 troops of the line, 400 artillerymen, 770 militia; and at Varinas, a company of troops of the line, consisting of 77 men.

Among the evils which repress the energies and retard the improvement of the inhabitants of Caraccas, the first place ought doubtless to be assigned to the Roman Catholic religion, which is here accompanied with all the horrors of the Inquisition. This dreadful tribunal has the power of condemning to fine, confiscation, banishment, the galleys, or the flames. In proscribing books hostile to their ideas of true religion or sound policy, the most pernicious exercise of their prerogative, the members of the inquisition are particularly vigilant. No book is allowed to be imported, circulated, or read, till it has received the seal of orthodoxy from the commissaries of the holy office. Every bookseller must provide himself with a catalogue of the books proscribed, and is bound to furnish, in the two first months of every year, an inventory of the books he has for sale, with his oath subscribed, that he has no other books than those named in the inventory. Even private persons, who enter the country with books, must make a detailed declaration of the contents of their library, confirmed by oath, which declaration is sent to the tribunal of the inquisition, or its commissaries, who have power to permit the introduction of the books, or to seize them. Should this declaration be omitted, or imperfectly made, the books are confiscated, and a fine of 200 ducats is exacted for the expences of the holy office. Books, when imported, are generally deposited at the custom-house, nor can the officers release them but by express permission of the commissary of the inquisition. Catalogues procured from abroad for the selection of books, must be sent before any use is made of them, to the holy office, which may retain or restore them. Should any person succeed in eluding the vigilance of the inquisition, he still possesses proscribed books by a very dangerous tenure, for he is perpetually exposed to those domiciliary visits which the commissioners of the inquisition have a right to make at any hour, either of the night or day. When we examine the list of books condemned by this rigid tribunal, we despair of the rapid progress of improvement among a people, from whom the richest treasures of literature, and even of science, are withheld, lest their eyes should be opened to the absurdities of a pernicious superstition, or to the abuses of an oppressive government.

From the difficulty of procuring permission to emigrate to any of the Spanish colonies, and the scrupulous care of government to ascertain the moral purity and sound orthodoxy of those to whom the permission is granted, we might naturally think that the inhabitants of Caraccas must be particularly exemplary in their character, and attached to the government. But the indolence and indifference natural to the Spaniards, seem to be so much increased by the heat of the torrid zone, as to form almost the only features in the character of the European as well as the Creole inhabitants of the captain-generalship of Caraccas. The moment a Spaniard is transported to South America, he seems to forget that he has a native country, and loses all desire to return. In the Creole, attachment to the parent country becomes, of course, more feeble. To obtain some public employment, which might distinguish him among his American countrymen, is the only motive which can induce him to visit the land of his forefathers; and to be adorned with the badge of office, is the only connection he desires with a government, to which, in other respects, he may be perfectly indifferent. However deeply, therefore, the Spanish government may seem to have laid the pillars of its sovereignty in Caraccas, and its other American colonies, we may expect to see the mighty fabric very speedily and generally subverted.

To become independent of Europe, was a wish very naturally inspired by the oppressive load of taxes necessary to support the government of a European monarch, and by the restrictions necessarily imposed on commerce by a monopoly which government patronised. This wish was confirmed, and increased in ardour, by the example of the British colonies in America; and, so early as the year 1797, the flame had nearly broke forth with a destructive violence. In that year, three state prisoners in Spain had been condemned to perpetual confinement in the casemates of Guayra. These men, who represented themselves as the martyrs of freedom, and the victims of despotism, had the art to form a very extensive conspiracy against government; and had the wish for independence been seconded by the activity of the people, there is reason to believe that the conspiracy might even then have been successful. It was prematurely discovered, and crushed. But liberty had now exerted among the people the magic of her name; and had kindled throughout the district of Caraccas a spark of discontent, which, however dull the materials on which it had to operate, was not likely to be extinguished till the fabric of the old government was violently shaken, if not entirely consumed.

Such was the state of the public mind when Miranda landed with an armed force on the shores of Caraccas, and unfurled the standard of revolt and independence. Round that standard the patriots were at first prevented from rallying, by the immediate danger of rebellion, and by the inherent indolence and timidity of their dispositions. But when the attention of government was withdrawn from the colonies to the distresses which began to multiply at home; when Spain was perfidiously invaded by the oppressor of Europe, robbed of her monarch, and her territory overrun by hostile armies; then insurrection began to appear more openly in Caraccas; and while the mother country was sunk in the lowest misery, her colonies were distracted by a fierce civil war.

From the very commencement of this insurrection, there appears to have been a strong faction in all parts of South America, determined to establish the absolute independence of the colonies. The professions of attachment to Ferdinand VII., and the sentiments of loyalty which pervaded their early proclamations, were intended to deceive those who were more moderate in their views; while severe invectives against the old government were mixed up with those loyal professions, in order to influence the passions of the lower orders. After thus preparing the mind of the public for some great change, the congress of Venezuela assembled on the 1st of July 1811, and resolved to renounce all allegiance to the Spanish king, and to declare their provinces independent of every foreign power.

In consequence of this resolution, which was not promulgated till some days after it was formed, many individuals, who held public situations, resigned their offices, others retired from the country, while the Spaniards and Canary Islanders formed conspiracies against the new government. Upon the discovery of these plots, many of the ring-leaders were executed in Caraccas, while others were confined in unhealthy prisons, and denied all communication with their friends. These examples of cruelty alarmed the peaceable inhabitants, numbers of whom sold their property, and fled to the United States, or to some of the neighbouring islands.

The junta of the Caraccas, which had been formed merely for temporary purposes, perceived the necessity of assembling a general congress; and the first act of this assembly was to place the legislative and executive powers in the hands of three individuals, who appeared qualified for this high trust by their abilities and their moderate views. The measures of the government were now carried on with great activity and zeal, but were sometimes interrupted by the interference of an assembly, called the Patriotic Society,* who met regularly to discuss political subjects, and who appear to have been influenced by the greatest hostility to the British government.

The city of Coro having refused to join the standard of the insurgents, the Marquis del Toro was sent against them with an armed force, but the Coreans quickly repulsed him with considerable loss. The town of Valencia, which stands upon the lake of the same name, formerly called Tacarigua, imitated the loyalty of the Coreans, and having been joined by an entire battalion of Pardos or people of colour, they openly proclaimed Ferdinand the Seventh. In consequence of this declaration, General Miranda marched against that city with the Caraquenian army, amounting to about 2600 men. Having passed the mountains of San Pedro, and descended into the valleys of Aragoa, he advanced without any molestation to La Victoria, from the heights of which he descended into the immense plains of Valencia. Several small gun-boats, equipped by the Valencians, were stationed on the lake, and concealed among the bushes and reeds which grow upon its banks; and when the Caraquenian army came to the village of Mariara, where the road follows the margin of the lake, they received some unexpected and well-directed shots from the gun-boats. The resistance of the gun-boats, however, was very feeble, and Miranda marched without opposition to the Morro, which is a round height and pass that commands Valencia. At this pass the Valencians resolved to try their strength; but after opposing a brave resistance to the enemy, they were compelled to retire with the loss of their chief engineer, and several pieces of cannon. From the entrance of the city, where they had rallied, the Valencians were driven into the great square, where, after a second stand, they were routed with the loss of all their artillery. The spirits of the Valencians, however, were not subdued by these disasters; a shower of balls was discharged from the flat roofs and strongly grated windows of the adjoining houses; and in attempting to force their way into the houses, and to take possession of the barracks, where the battalion of Pardos were posted, the Caraquenians were every where repulsed. After having kept possession of the town for ten hours, they were forced to abandon it, with the loss of all their artillery, several prisoners, and two hundred men killed or severely wounded, and never halted till they reached Guacara, which is more than four leagues from Valencia. The number of Valencians who were armed did not exceed seven hundred men.

The army of Miranda, receiving reinforcements from various quarters, was, in less than a fortnight, enabled to advance upon Valencia, while, from the desertion of the whites, the Valencians were reduced to less than 500 armed men. On the 8th of August he attacked the Valencians in the valley of Palotal, and on the heights of El Puto and Agua Blanca, which were taken after an obstinate resistance. The Caraquenian light infantry followed the Valencians into the city, which they had defended by forming new ditches and intrenchments in the principal streets which led to the great square, and after being attacked on eight different points at the same time, they were at last closely hemmed in. Their strength being now greatly weakened by desertion, and being without water and provisions, they surrendered at discretion on the 13th August, and the flotilla of gun-boats, which had been equipped upon the lake, was also given up.

While the Caraquenians were thus establishing their power in Valencia, an army of Coreans had advanced for its relief, as far as San Felipe on the west, while the Guyanese, who had also remained steady to the mother country, had extended their troops nearly to Calvario on the west. In this state of affairs the government of the Caraccas adopted a system of severity and vigilance suited to the dangers that menaced them: They instituted a tribunal of vigilance, which paid domiciliary visits, and ordered arrests upon the slightest suspicion; the theatre was shut, and all balls and concerts, and even private parties, were at an end. The people were regularly trained to the use of arms, and it became the fashion for persons of the greatest distinction to sleep at the barracks; a law was passed for the abolition of torture, and the liberty of the press was established.

It would be out of place here, even if we were possessed of authentic materials, to enter into a more detailed account of the proceedings of Miranda and his party, or to follow them in the various steps of their progress. We may only observe, that the revolutionary party is daily gaining strength, and that their armies are almost constantly victorious. Atrocities are committed on both sides, from which the mind revolts with horror; yet we anticipate, with no small degree of satisfaction, the emancipation of a people possessed of one of the finest countries in the world, from a system of tyranny and oppression, which paralyzed all their energies, and deliberately repressed the exertions of their industry, lest it should interfere with the interests of the mother country. See Depon's *Travels in South America*; Humboldt's *New Spain*; and Semple's *Sketch of the present State of Caraccas.* (*k*)

CARACCI, Agostino, an eminent Italian painter, was born at Bologna in 1558, and died in 1602. He studied first in the school of Prospero Fontana, and became afterwards the disciple of Passeroti. He was chiefly indebted, however, to his cousin Ludovico, for that genuine taste and knowledge of the true principles of painting by which his pieces were distinguished. The merit of the few paintings which he executed, has made subsequent artists regret, that an uncommon diffidence in his own powers induced him to devote more of his attention to engraving, after the works of others, than to the extension of his fame by original productions. His most celebrated work in oil, is the Communion of St Jerome, which was formerly at the Certosa in Bologna, but is now with the rival picture of Domenichino, among the spoils of the Louvre. In the comparison of these two pictures, the preference has generally been given to that of Domenichino; "but surely," says Mr Fuseli, "if Agostino yields to his scholar in repose, and the placid economy of the whole, he far excels him in the principal figure, the expression, and character of the saint." Agostino is said to have assisted his brother Annibale, as well in the disposition, as in the execution of the Farnesian Gallery; and it is even thought that Annibale has received the credit of several of the pieces which were finished by Agostino. A cultivated taste, a correctness.

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* About six months after the arrival of General Miranda, he was elected president of this club, and he is said to have immediately introduced four Mulattoes as members.

and sometimes elegance of form, and corregiesque colour, especially in fresco, are the distinguishing qualities in the style of this master. (μ)

CARACCI, Annibale, brother to Agostino, was born at Bologna in 1560, and died in 1609. From his cousin Ludovico, who first put the pencil into his hands, he not only learned the best principles of the art of painting, but caught an ardent ambition to excel in its various branches. For this purpose he studied, with keen emulation, the works of Titian, Tintoretto, and Paolo Veronese, at Venice, and those of Corregio at Parma. The genius displayed in his early productions excited great expectations of his future eminence. His fame soon extended itself to Rome; and he was invited by the Cardinal Farnese, to paint that gallery, which became afterwards so well known through all Europe. In this magnificent undertaking, he spent ten years of assiduous labour. The Farnesian Gallery, while its colours withstand the influence of time, will remain an honourable monument of the talents of the painter, while it throws a shade of perpetual infamy over the memory of his employer, who could requite such talent, laboriously and successfully exerted for ten years, with the paltry sum of five hundred crowns. Uniform vigour of execution is the distinguishing excellence of this celebrated work; an excellence, however, which is most unhappily contrasted by its imbecility and incongruity of conception. "If impropriety of ornament," says Mr Fuseli, a little too strongly, "were to be fixed by definition, the subjects of the Farnese Gallery might be quoted as the most decided instances. The artist may admire the splendour, the exuberance, the concentration of powers, displayed by Annibale Caracci, but the man of sense must lament their misapplication in the Farnese Gallery." Annibale availed himself of his residence in Rome, by studying the antique statues, the basso-relievos, and the compositions of Raphael. These models induced him to change his Bolognese manner, which had much of Corregio in it, for one which was indeed more learned, but, both in design and in colouring, more dry and less natural. In comparing Annibale with the other Caraccis, it may be observed, that while he was perhaps inferior to Ludovico and Agostino in refined taste, sensibility, and judgment, he surpassed them both in the freedom, the warmth, the energy and originality of conception, by which true genius is characterised. In his paintings there is little of that delicacy which diffuses through the soul a silent pensive delight; but the grandeur of his designs, the liveliness of his expression, the vigour and firmness of his execution, burst in one powerful effect upon the mind, and hurry it away in a kind of impetuous admiration. He painted portraits and history; but it was in landscape that he chiefly excelled. The form of his trees is peculiarly grand; and though he does not appear to have understood completely the principles and doctrines of the chiaro obscuro, and his local colours are not always commendable, yet "no painter seems to have been more universal, more easy, more certain in every thing he did, nor more generally approved, than Annibale Caracci." (μ)

CARACCI, Ludovico, the cousin-german of Annibale and Agostino, was born at Bologna in 1555, and died in 1619. He studied under Prospero Fontana; but it was by contemplating the works of Titian, Tintoretto, and Paolo Veronese at Venice, and of Parmigiano and Corregio at Parma, that he refined his taste, and formed those elevated conceptions which characterise his paintings, and which have raised him to the distinguished eminence which he still holds among artists. He laid the foundation of that school which was distinguished by the title of the Academy of the Caraccis, and which became so highly celebrated. To this academy every student resorted who gave hopes of future eminence; and some of the noblest masters in the art had been the disciples of Ludovico. The advantages which they enjoyed in his academy were singularly attractive. The discrimination of Ludovico was not inferior to his other talents, and he directed the studies of his pupils to those departments of the art for which nature seemed peculiarly to have designed them. He had established at a great expence, well chosen models of men and women; and had collected at Rome a number of fine casts from the best figures, and some antique statues and curious basso-relievos. He took care to procure the most capital designs of the great masters; to purchase instructive books on all subjects relative to the art; and engaged the assistance of a very skilful anatomist, who taught the disciples whatever might be necessary to be known relative to the knitting of the bones, and the insertion of the muscles. His cousins, who were his pupils, were afterwards employed along with him in the management of this academy. The style of these great masters was nearly the same, varied only by the diversity of disposition and temper. Ludovico, with less fire and vigour than Agostino and Annibale, surpassed them in the more pleasing, though less commanding, qualities of grace, dignity, and sweetness. Mr Fuseli, who gives him the decided preference to both, has so well appreciated and described his manner, that we cannot forbear transcribing his own animated words. "Ludovico Caracci, far from subscribing to a master's dictates, or implicit imitation of former styles, was the sworn pupil of nature. To a modest but dignified design, to a simplicity eminently fitted for those subjects of religious gravity which his taste preferred, he joined that solemnity of hue, that sober twilight, that air of cloistered meditation, which has been so often recommended as the proper tone of historic colour. Too often content to rear the humbler graces of his subject, he seldom courted elegance, but always when he did, with enviable success. Even now, though they are nearly in a state of evanescence, the three nymphs in the garden scene of S. Michele in Bosco, seemed moulded by the hand inspired by the breath of Love. This genial glow he communicates even to the open silvery tone of fresco. His masterpiece in oil is the altar-piece of St John the Baptist, formerly in the Cortosa of Bologna, now in the Louvre, a work all sainted by this solemn hue, whose lights seemed embrowned by a golden veil. But Ludovico sometimes indulged and succeeded in tones austere, unmixed, and hardy: such is the Flagellation of Christ in the same church, of which the tremendous depth of the flesh tints contrasts with the stern blue of the wide-expanded sky, and less conveys than dashes its terrors on the astonished sense." (μ)

CARACTACUS. See Britain, p. 548.

CARALLUMA, a genus of plants of the class Pentandria, and order Digynia. See Botany, p. 174.

CARAMANIA, or Caraman-ili, as it is called by the Turks, is a province of Asiatic Turkey, which stretches along that part of the Mediterranean which lies to the north of the island of Cyprus, and extends a little to the west of Cape Volpe, near the Isle of Rhodes. This province formerly comprehended the ancient countries of Pamphylia, Lycia, Pisidia, Lycaonia, Isauria, Ci licia, part of Phrygia, Galatia, and Capadocia. The part of the coast of Caramania, which once formed Pamphylia, is washed by very deep water, so that ships may approach very near it, without the risk of running aground. The coast is in general elevated and dry, and is broken by numerous intersections. The mountains behind the coast have a gloomy green appearance, and are covered with vast forests, which are either neglected or destroyed by the Turks. At the island of Castel Rosso, (the *Roge* of Pliny), there is an excellent harbour open to navigators; but the depth of water within it is so great, that ships are under the necessity of anchoring in 60 or 80 fathoms. There is a fortified castle on the summit of the rock which forms this island. The part of the coast of Caramania, from Castel Rosso to the entrance of the Gulf of Macri, is not so high as the coast to the eastward, but it is equally perpendicular, and it consists of a white and arid rock, and is divided by large ravines. The admirable havens in the Gulf of Macri, are sufficient for containing large fleets: Four of the havens which are most retired, are frequented by a few vessels during the winter months, when the navigation of the Archipelago is dangerous. The crews were allowed to cut down the finest trees at no expence, and without any interruption from the inhabitants; and after refitting their vessels, they carried cargoes of wood to the ports where it brought the highest price. The immense variety of game and fish furnished them, at the same time, with plenty of food, and with numerous sources of amusement.

"If the wind has ever so little strength," says Sonnini, "the sea is always very high in the strait formed by Caramania and the island of Rhodes. The waves rise there sometimes in a frightful manner; the currents, which, in a sea intersected by islands and projecting lands, vary and clash, are the cause of this extraordinary agitation, which is likewise increased by inconstant and irregular winds. Indeed, it frequently happens, that the wind is different in several parts of the same channel, and that, on one side, there reigns a flat calm, while, on the other, the winds blow with violence. Not only are the winds inconstant in these obstructed seas, but they are here felt by sudden and impetuous squalls, which are followed and preceded by dead calms; and these violent gusts are sometimes announced by infallible signs.

Above the high mountains, of which the coast of Caramania is for the most part formed, it is not uncommon, in clear weather, to see a very small black cloud, frequently no bigger in appearance than a bird. This globe of vapours is extremely agitated; at first very small, it spreads all on a sudden, contracts, appears, and disappears, at intervals, above the mountains, and changes its form every instant. How calm soever the atmosphere may be, a sudden and violent squall may be expected at the sight of these insulated clouds, which discharge the wind with so much rapidity and vehemence, that if a ship be not prepared for being overtaken by it, she runs a great risk of losing part of her sails, and even her masts and yards. On the 28th of October, we experienced one of these sudden squalls, after a calm which had kept the ship stationary abreast of Cape Crio, a large promontory of Caramania. During this calm, a numerous shoal of fishes, cleaving the water level with its surface, and even darting above it, passed close to us with great rapidity; and the agitation of these inhabitants of the depths of the sea, is always a certain presage of an approaching and violent agitation in the atmosphere and the waters. A small cloud, the precursor of the storm, had made its appearance above the promontory; it expanded, and we were overtaken by a gale of wind, which compelled us to take in all our sails, and continue lying-to during the whole night, tossed about by short and overgrown billows."

There are several lakes in Caramania which are well stored with fish, and furnish salt in abundance. A great deal of silk is also produced here. Attalia, or Satalia, situated upon a gulf of the same name, is the capital of the province. See Sonnoni's *Travels in Greece and Turkey*, Eng. edit. 4to. 1801, p. 73—119; Chateaubriand's *Travels in Greece*, *Palestine*, &c. vol. ii. p. 227; and *Views in Palestine and Caramania*, *from the original drawings of L. Mayer*, *with an Historical and Descriptive Account of the Country*, &c. London, 1804. (π)

CARAPA. See Persoonia, *Botany Index*.

CARAVAN, from the Arabic *Cairawan*, and the Persian *kervan*, a trader, is the name given to a company of merchants or pilgrims, who travel through the deserts in a body, in order to be secure against the attacks of the Arabs and robbers with which they are infested.

In the articles Arabia, Asia, and Cairo, we have already given an account of some of the principal caravans of Asia; and we shall therefore confine our attention at present to those of the African continent.

A very extensive and lucrative commerce has from time immemorial been carried on between Timbuctoo, the great emporium of Central Africa, and the maritime states of Marocco, Tunis, Algiers, Tripoli, and Egypt, by means of *akkabaahs*, or accumulated caravans. These caravans consist of several hundred loaded camels, attended by the Arabs, who let them at a low rate to the merchants, and they generally cross the great desert of Sahara between the months of September and April inclusive. The line of their march is extremely irregular, as they are obliged to turn out of their direct route to fall in with the fertile and cultivated spots called Oases.* The caravans remain at each of these Oases about seven days; and after being supplied with water, and feeding and refreshing the camels, they proceed to another spot of the same kind.

Upon the arrival of the caravans at Akka, situated in Lower Suse, on the confines of the desert, the guides and camels are discharged, and others are hired to proceed to Fas, Marocco, Terodant, Tafilelt, and other places. Including the sojournments at the Oases, the caravans traverse the desert in about 130 days. Setting out from the city of Fas, and travelling 7 hours a day, at the rate of 3½ miles an hour, they arrive at Wedinoon, Tatta or Akka, in 18 days, where they remain. It is from the latter place that the grand accumulated caravan proceeds. Sixteen days are spent in the journey from Akka to Tagassa, and after remaining fifteen days to replenish their camels, they proceed to the Oasis and Well of Taudeny, which they reach in seven days. Here they stay 15 days, and in seven days they make the watering place called Arawan. After a stay of 15 days, they reach Timbuctoo on the sixth day. The time employed in this journey is therefore 129 days, 75 being spent in rest, and 54 in actual travelling. On some occasions this journey is completed in the short period of 82 days.

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* The Arabic name of these cultivated spots is *Elwah*, hence *Wahs* or *Oas*, and *Oasis*, or *Wahsis*. The plural in the Arabic is *El Wahaht*.

Another caravan sets off from Wedinoon and Sok Assa, and crossing the desert between the black mountains of Cape Bojador and Gualata, touches at West Tagossa, and after remaining there for some time to collect salt, it proceeds to Timbuctoo. This caravan employs five or six months in its journey, as it goes as far as the White Mountains near Cape Blanco, through the desert of Mograffra Woled Abussebah, to a place called Agadeer, where it remains twenty days.

"The akkabaahs which cross the desert," says Mr Jackson, "may be compared to our fleets of merchant vessels under convoy; the *stata*, or convoy of the desert, being two or more Arabs, belonging to the tribe through whose territory the caravan passes; thus in passing the territory of Woled Abussebah, they are accompanied by two Sebayhees, a people of that country, who, on reaching the confines of the territory of Woled Deleim, receive a remuneration, and return, delivering them to the protection of two chiefs of Woled Deleim; these again conducting them to the confines of the territory of the Mograffra Arabs, to whose care they deliver you, and so on, till they reach Timbuctoo. Any assault made against the akkabaah during this journey, is considered as an insult to the whole clan to which the (stata) convoy belongs, and for which they never fail to take ample revenge.

"Besides these grand accumulated caravans, there are others which cross the desert on any emergency, without a stata, or guard of soldiers; but this is a perilous expedition, and they are too often plundered near the northern confines of the desert, by two notorious tribes called Dikna and Emjot. In the year 1798, an akkabaah consisting of two thousand camels loaded with Soudanic produce, together with 700 slaves, was plundered and dispersed, and many were killed. These desperate attacks are conducted in the following manner: A whole clan picket their horses at the entrance of their tents, and send out scouts to give notice when an akkabaah is likely to pass; these being mounted on the heirie, or shrubba er'reeh, quickly communicate the intelligence, and the whole clan mount their horses, taking with them a sufficient number of (niag) female camels, to supply them with food, (they living altogether on the milk of that animal;) they place themselves somewhere in ambush near an Oasis, or watering place, from whence they issue on the arrival of the akkabaah, which they plunder of every thing, leaving the unfortunate merchants entirely destitute."

The manners and customs of the merchants, during these long and dangerous journies, are extremely simple and natural. Prohibited by their religion from the use of intoxicating liquors, their only nourishment consists of a few dates and a draft of water, and when their journey is only for a few weeks, a little barley meal and cold water is their only food. Animated by the hopes of reaching their native country, they often sing during their journey, and when the camels are fatigued, or when they approach a habitation, their songs are sung in trio, all the camel drivers joining in the chorus. The camels march in time to the music, and seem for a while to forget their fatigue. The day's journey is generally terminated about four o'clock, and after pitching their tents, and saying their prayers, they prepare their supper; as soon as it is ready, they seat themselves round in a circle, and talk till they are overcome by sleep. At break of day they again proceed upon their journey.

In the course of these journies, the hot winds called *shume** are often so violent as to evaporate all the water carried in skins for the use of the passengers and drivers; and Mr Jackson was informed by the Arabs and the people of Soudan, that on these occasions, 500 dollars have been given for a draft of water, and that 10 or 20 dollars are very frequently given when a partial evaporation has taken place. A caravan proceeding from Timbuctoo to Tafilelt in the year 1805, was disappointed at not finding water at one of the Oasis, and the whole party, consisting of 2000 men and 1800 camels, perished of thirst.

The dangers arising from the drifting of the sand, are often very considerable. When the loose sand is drifted along the plains by the shume, the akkabaahs are obliged suddenly to strike their tents, otherwise they would be all buried in the overwhelming torrent. On these occasions the desert has the appearance of a sea, as the drifting sand has a striking resemblance to the waves of the ocean. Hence the desert is emphatically called by the Arabs a *sea without water*.

The merchandise which is carried by these caravans are German linens, viz. plattilias, rouans, bretannias, muslins of different qualities, particularly muls, Irish linens, cambrics, fine cloths of different colours, coral and amber beads, brass nails, pearls, raw silk from Bengal, coffee, hyson teas, refined sugar, and various manufactures of Fas and Tafilelt, namely shawls and sashes of silk and gold, hayks† of silk, of cotton and silk mixed, and of cotton and wool, and Tafilelt hayks. To these may be added woollen caps, which is the general covering for the head, turbans, Italian silks, cloves, nutmegs, ginger and pepper, cowries, Venetian beads, and a great quantity of tobacco and salt, which is the produce of Barbary and Bled-el-jerrede.

The articles which the caravans receive in exchange for these goods, are chiefly the produce of Soudan. They consist principally of gold dust, twisted gold rings of Wangara, open at the extremity for the insertion into the cartilage of the nose; gold rings made at Jinnie;‡ bars of gold, elephant's teeth, gum of Soudan, grains of Sahara (or grains of paradise;) odoriferous gums, called *el b'korr'h Soudan*, employed for fumigation, and supposed to possess many virtues; and a great number of slaves from the slave-merchants of Wangara and Houssa, who bring them from the regions which border on the Mountains of the Moon. The Wangareen slaves are a gross stupid people, scarcely above the level of the brute creation: while those from Houssa are acute, industrious, and intelligent, and have an open and noble countenance. The latter are therefore sold at a much higher price. The average price of a slave is about one hundred ducats (3s. 8d. sterling each;) but Mr Jackson once saw a young girl of Houssa, of exquisite beauty, sold at Marocco for 400 ducats. Ambergris and ostrich feathers, collected on the confines of the desert, are added to the merchandise already mentioned. Mr Jackson, to whom we are indebted for the preceding information, has given a map shewing the track across the desert, as followed by the caravans from Fas to Timbuctoo.

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* At 20 leagues from land, in West Long. 11° 30′, and North Lat. 30°, Mr Jackson collected from the deck of the ship a wine glass full of the sand carried by these violent winds

† A light and durable piece of cloth, about fourteen feet long and six feet wide. It is used as an outer garment by the northern Africans of that place. The Tafilelt hayks are a light manufacture, well fitted for the climate of Soudan.

‡ The natives of Jinnie seem to excel Europeans in working gold. Mr Jackson informs us, that he has seen trinkets, particularly the figure of an eagle, of such workmanship, that it would have been difficult to imitate them either in England or France.

Besides these caravans, there are three which are employed in carrying slaves and other commodities from the interior of Africa to Cairo. The first of these sets out from Mourzouk, the capital of Fezzan, the second from Sennaar, and the third from Fur. The caravan from Mourzouk consists of between 100 and 300 travellers from the empires of Bornou and Cashna, from the kingdom of Caffaba, and from several of the negro states. It sets out almost every year in the end of October, or in the beginning of November, and generally finishes the journey in about 52 days. The following is a Table of its route to Caire :

Days.
7th, Reach Temissa.
9th, Arrive at the lofty rock of Xanibba, where they get a supply of water.
13th, Pass over a desert of black and naked rock.
17th, Cross a desert of soft and sandy stone, and reach the mountain of Ziltan.
21st, Four days spent in the passage of this mountain.
25th, Cross the sultry plain between Ziltan and the green heights of Sibbeel.
26th, Arrive at Augela, subject to Tripoli.
27th, Reach the village of Gui Xarrah.
28th, Arrive at the ascent of Mount Gerdobah.
33d, Five days spent in passing this mountain.
36th, March through the plain of Gegabib, fertile in dates, and reach the desolate mountain Buselema.
39th, Enter the republic of See-wah.
40th, Proceed from See-wah the capital, to the village of Umseguer, at the foot of the mountainous desert of Le Magra.
47th, Arrive at the convent of monks on the hill of Huaddy l'Ottron.
52d, Reach Cairo.

The caravans from Sennaar and Dar-Fur are very irregular in their motions, arising from the revolutions which are constantly taking place in their unsettled governments. Sometimes two or three years elapse without any of them arriving at Cairo. The number of independent Arabs, who infest the roads between these two places and Cairo is very great, and contribute to the irregularity of these Caravans.

One of the finest descriptive pictures of the manners of a caravan that was perhaps ever drawn, without the aid of a pencil, is given by Chateaubriand, in his Travels into Greece and Palestine. "It was midnight, says he, when we arrived at the Kan of Menemen. I perceived at a distance a great number of scattered lights; it was a caravan making a halt. On a nearer approach, I distinguished camels, some lying, others standing; some with their loads, others relieved from their burdens. Horses and asses without bridles, were eating barley out of leather buckets; some of the men were still on horseback, and the women, veiled, had not alighted from their dromedaries. Turkish merchants were seated cross-legged on carpets, in groupes round the fires, at which the slaves were busily employed in dressing pilau. Other travellers were smoking their pipes at the door of the kan, chewing opium, and listening to stories. Here were people burning coffee in iron pots; there hucksters went about from fire to fire, offering cakes, fruits, and poultry, for sale. Singers were amusing the crowd; imans were performing their ablutions, prostrating themselves, rising again, and invoking the prophet; and the camel-drivers lay snoring on the ground. The place was strewed with packages, bags of cotton, and couffs of rice. All these objects, now distinct, now confused and enveloped in a half shade, exhibited a genuine scene of the Arabian Nights." See Chateaubriand's *Travels in Greece, Palestine, Egypt, and Barbary*, vol. i. p. 303, 304; Volney's *Voyage en Syrie et en Egypte*, vol. ii.; Russel's *History of Aleppo*; Pococke's *Description of Egypt*, vol. i. p. 188—261; Maillet *Description de l'Egypte*, Paris, 1740; Rennel, *Phil. Trans.* vol. lxxxi. p. 129; Jackson's *Account of Marocco*, p. 237; and Browne's *Travels in Africa*, chap. 18. See also the articles Arabia, Asia, Barbary, and Cairo. (π)

CARAVANSERA, or Caravanseray, the name given in the East to the large inns or public buildings, for accommodating the merchants, pilgrims, and travellers, that accompany the caravans.

The caravenseras have generally been confounded with the *khans*; but the former, particularly about the time of their origin, were erected under the impulse of religious duty, in desert places, at a distance from large towns, to afford shelter and accommodation to travellers and caravans; while the *khans*, which were generally built in towns, were used by foreign merchants, not only as a lodging-house, but as a magazine for their goods. The word *caravansera*, however, is the general name adopted in Asia for all these kinds of buildings. It is used not only in Turkey, but also in Persia and the Mogul country, while the word *khan* is more particularly used in Turkey.

But while the charity and hospitality of the Eastern princes have thus provided accommodation to travellers in those desert regions, where it is most required, they have limited their generosity to a mere shelter from the inclemency of the weather, and to a supply of water, which is often brought from a great distance. Neither beds, kitchen, nor provisions, are attached to these buildings; and the traveller must either carry along with him every thing that he wants, or purchase them after his arrival. The caravanseras, as well as the khans, are generally huge square buildings, being one or two stories high above the ground-floor. The interior façades, which form the spacious court or hall in the middle, resemble the cloisters of convents. The magazines are in the ground-floors, while the chambers for travellers are in the upper stories. A reservoir of water, in which the camels and other beasts of burden quench their thirst, is placed in the middle of the court.

In the city of Fas, in Marocco, there are no fewer than two hundred caravanseras, called Fondaque. These edifices are three stories high, and contain from 50 to 100 apartments, in each of which a supply of water, for ablution and other purposes, is conveyed by means of a water-cock. The traveller must carry bedding along with him, as they are provided only with a mat; and if he wants any refreshments, he must order them from a cook's shop, or buy them from a butcher, and dress them himself. A certain sum per day is paid for the use of the apartment.

The caravanseras of Constantinople, Ispahan, and

Agra, are celebrated for their magnificence and accommodation. Those of Sheeraz and Casbin are said to have cost 60,000 crowns each; and that of Vrana or Urana, in Dalmatia, which is now in ruins, had a façade 150 feet long. It was built entirely of fine marble, with a compact grain, and susceptible of the finest polish; and the Abbé Fortis supposed that those blocks of marble had been taken from some Roman building.

The permission to build a caravansera, has always been considered in Turkey as a mark of distinction. At one time, however, this privilege was bestowed only upon the mothers and sisters of the sultans, and upon the viziers and bashaws who had gained three victories over the Christians. For an account of several of the caravanseras in Persia, see Morier's *Journey through Persia, Armenia, and Asia Minor*, p. 81, 153, 154, 272; and Jackson's *Account of Marocco*, p. 131. and 256. (*w*)

CARAUSIUS. See Britain, p. 551.

CARBON. See Charcoal and Chemistry.

CARBONATES. See Chemistry.

CARBONIC Acid. See Chemistry.

CARBURET. See Chemistry.

CARCASS, is the name of a hollow body, containing combustible matter, and thrown from mortars for the purpose of setting fire to houses. The case is sometimes made of ribs of iron, covered with pitched cloth, &c. and is sometimes an iron shell, with three or four openings, through which the fire issues. Carcasses are said to have been first used at the siege of Groll in 1672, by the Bishop of Munster.

The following Table contains the result of a series of experiments, made with round case carcasses at an elevation of 45°.

No.	Size of the Mortar.	Weight of the Carcass.	Quantity of Powder.	Time of Flight.	Time of Burning.	Length of Burning.	Range in Feet.	Observations.
		lb. oz.	lb. oz.	Seconds.	Min. Sec.	Inches.	Feet.	
1	10	62 13	0 8	6	3 0	2.7	390	The carcasses No. 1, 2, and 3. were fired between 7 and 9 o'clock in the morning. They burnt well in general, and gave a good light.
2	10	64 12	0 12	8	3 12	2.7	774	
3	10	70 0	1 0	10	3 40	2.7	882	
4	10	71 12	1 4	11.5	4 0	2.7	1332	The carcasses No. 4, 5, and 6, were fired between 2 and 4 o'clock in the morning, when it was very dark, and they furnished a very good light.
5	10	72 0	1 12	13	4 18	2.7	1815	
6	10	68 10	2 0	14	4 45	2.7	2043	
7	8	33 7	0 6	6	3 4	2.7	411	The carcasses No. 7, 8, 9, 10, and 11, were fired between 10 o'clock at night and 2 in the morning, and had a very good effect.
8	8	36 12	0 10	8	3 20	2.7	963	
9	8	35 8	0 14	12	5 0	2.7	1344	
10	8	34 14	1 0	14	3 40	2.7	1680	
11	8	32 12	1 4	13	5 10	2.7	1908	

The following experiments were made at Woolwich with round Iron Carcasses, in the year 1773.

No.	Size of the Mortar.	Size of Carcass.	Weight when empty.	Weight when full.	Quantity of Powder	Elevation.	Range.	Observations.
	Inches.	Inches.	C. qr. lb.	C. qr. lb.	lb. oz	D. M.	Feet.	
1	13	13	1 2 27	1 3 12	30 0	45 0	8700	In the course of the two first experiments, a small piece burst from the carcass, and fell at the distance of 4500 feet. The other piece contained the composition. In the two last experiments the carcass did not break.
2	13	13	1 3 1	1 3 14	30 0	41 0	9000	
3	13	13	1 3 3	1 3 6	30 0	42 0	10200	
4	13	13	1 1 4	1 3 17	30 0	42 30	10500	

CARCASSONE, anciently Carcaso, the capital of the department of the Aude, is situated upon the canal of Languedoc, and also upon the river Aude, which divides the town into two parts, called the Upper and the Lower Town, both of which are surrounded with a wall. The upper town, which is situated upon an eminence, is called the City, and, besides the cathedral, contains a castle, which is very strong, and commands the whole town. In this castle are kept the ancient records, which are written upon the bark of trees. The lower town, which is almost square, consists of streets intersecting each other at right angles, and leading to a large square in the centre, which is ornamented with a fountain of rockwork, surmounted by a figure of Neptune. The quays, which are adorned with rows of trees, form agreeable promenades.

From Carcassone strangers generally go to Barbayrac, on the road to Trebes, to see the Languedoc canal pass over an aqueduct bridge across the river Orbe.

In this town, the manufacture of drabs of all kinds is carried on to a very considerable extent. They are made of the wool of Bezieres, Narbonne, and Spain, and are sold at Lyons, Bourdeaux, Thoulouse, and other towns of France. The quantity which is annually sent off amounts to about 16,000 pieces. The inhabitants of the town and the adjacent country are employed in carding, spinning, and preparing the wool, and such is the industry of the people, that a beggar is not to be seen in the country. The inhabitants of the six villages which compose the district of Graissesac, some leagues from Carcassone, are employed in fabricating copper goods. Population 15,300. E. Long. 2° 5′, N. Lat. 43° 11′. See *Histoire de Carcassone*, par Pere Bouges. (*o*)

CARDS.

CARDS, in the manufactures of cotton and wool, are instruments used for preparing the fibres of those substances for spinning them into thread, by straightening the fibres, and rendering them parallel to each other, so that each may have its full bearing and proper tension, when a number are twisted together to form a thread.

The card is a kind of brush made with wires instead of hair, stuck through a sheet of leather, the wires not being perpendicular to the plane of the leather, but all inclining one way at a certain angle.

From this description, such as are totally unacquainted with the subject may conceive, that cotton, being stuck upon one of these cards, or brushes, may be scraped with another card, in such a direction, that the inclination of the wire may tend to throw the cotton inwards, rather than suffer it to come out. The consequence of the repeated strokes of the empty card against the full one, must be a distribution of the cotton more evenly on the surface; and if one be then drawn in the opposite direction across the other, it will, by virtue of the inclination of its wires, take the whole of the cotton from that card whose inclination is in the contrary direction.

In this way the operation of carding was formerly performed by the hand, with sheets of card nailed upon thin boards, which were drawn and scraped against each other till the cotton or wool was evenly diffused over the surface, and freed from all the knotty or entangled parts. One of the cards being then turned, and applied in an inclined position, so as to scrape with one edge over the surface of the other card, in the direction of its teeth, the cotton was, by a particular manœuvre, stripped off, and coiled up into those short soft rolls, which were called Cardings, and were afterwards extended and twisted by the spinning wheel.

Such, in all probability, was the process employed, with little alteration, during the five last centuries, in the woollen manufacture of this kingdom, and applied, at subsequent periods, to the preparation of cotton. The use of cards was most likely derived from the Netherlands, at or before the time that our woollen manufactures were improved by the emigration of Flemish weavers to this country during the reign of Edward III.

Cards continued to be imported till the year 1463, when the tradesmen and manufacturers of London, and other parts of England, having made heavy complaints to parliament, of the obstruction to their own employment by the introduction of various foreign manufactured wares, an act was passed in the third year of Edward IV. prohibiting wool cards, among various other articles of iron, steel, copper, &c. from being imported into this kingdom.

The hand cards were succeeded by stock cards, and these again by cylinder cards, which were brought into extensive use by Sir Richard Arkwright in 1771. (See COTTON *Manufacture.*) Since this period, the consumption of cards for cotton mills has been immense. A very small carding machine will contain upwards of 150,000 card wires of the coarsest kind; and we have visited an establishment of cotton mills, where 150 of such carding machines were in constant work. Thirty or forty machines are a very common number to find in one mill; and these are so numerous, as to make a very extensive trade in card manufacture.

Wool cards are of a coarser and stronger kind than those used for cotton, but are applied in the same manner, either on boards, for hand carding, or covered on cylinders for carding machines, as explained under the articles COTTON *Manufacture* and WOOLLEN *Manufacture*. The card wires are the same for either of these purposes, except in size. The wire is bent into a staple, in the manner shewn at Fig. 1. of Plate CXI. and the legs of this staple are crippled, or bent, in a second direction, as shewn by the figure Y, which shews a card wire ready for fixing the leather by, the two legs being stuck through two holes in the sheet of leather. This fastens the teeth firmly in their places; and then the bend in the legs, which is called the knee bend, gives the teeth their proper angle of inclination, as is shewn in the section of a sheet of cards at Z, Fig. 1. X is a view of the back of the leather, shewing the arrangement of the wires; which is such, that the adjacent wires do not fall behind each other, but, by filling up the intermediate spaces between each, renders the cards finer, the teeth being equally dispersed over the surface of the leather.

The cards used in the hand are called sheet cards; and the direction of the wire joining the two legs is parallel to the length of the sheet. Sheet cards of a greater length are also used for the top cards, or lugs of the carding machine, and also for the great cylinders. Another kind are called *fillet cards*, being straps or fillets of leather, and the wire stuck across them. It is this kind of fillet which is shewn at X, Fig. 1. It is only used in the machine cards, when the fillet is wrapped spirally round the small cylinders to cover all its surface.

The immense number of cards required in the cotton mills, causes the manufacture of cards to be very extensive; and several very curious machines have been invented for facilitating the processes, though they have not yet come into general use. In the present state of the trade, the principal seats of which are the countries about Glasgow and Leeds, the processes are divided into the preparation of the wires and the leather. The latter is pierced by machinery at the house of the manufacturer, who sends it out to the cottagers, together with the wire, which they cut and bend by three operations. (one performed by a machine); and the women and children insert them into the holes of the leather. The three operations of making the wires, are, 1st, Cutting to length, 40 or 50 being cut together; 2d, Doubling, which gives them the form at *v*, Fig. 1.; and, 3d, Giving the knee bend Y, which is done by a little machine placed close to the doubler's seat. We shall describe these operations in order, as they follow each other.

Cutting. The workmen clips off the wires from a coil, or skaine, making 30 or 40 turns; so that this number of wires are cut off at once, by a pair of strong shears fixed at the edge of the work bench, and moved by pressing the foot upon a treadle. A weight over a pulley is the re-action for opening them when the pressure is relieved. By this means the workman has both hands at liberty: in one he holds the end of the skaine, or bundle of wires, and applies the ends to a gauge, which has an adjustable stop, to determine the length of wire to be cut off from the end, when the end of the gauge is held in contact with the blade of the shears, and one tread cuts them off. By this means 30 or 40 wires are cut at every stroke to the intended length, for which the stop of the gauge is previously adjusted.

Doubling or bending the wires to the form of a staple. The wires are held in a tool adapted to the purpose, called a *doubler*, and bent by the pressure of another tool, called the *bender*, which is formed like a small reaping hook, but without any edge. The doubler is a wooden handle, having a steel gauge fixed in the end of it, to the stop of which the ends of the pieces of wire are applied, and doubled into the form of a staple, over a small flat bar of steel (*bridge*) fixed in the doubler, perpendicular to the length of the wire; and by means of the stop of the gauge, the proper part of the wire is presented to the bridge, so that the two ends or legs of the staple, when formed, shall be exactly of the same length: The bridge is, of course, the same breadth as the distance between the two legs and points of the staple, which is formed by bending or doubling the wire over it. The workman, having adjusted the wires in the doubler, presses the bender (held in the other hand) against them; and thus, by one operation, bends them to the form of the letter L, over one angle of the bridge, and by repeating it over the other angle doubles them, forming 30 or 40 staples together very quickly.

Bending. The workman now removes the wires from the bridge of the doubler by a small steel knife, or spatula, introducing its point under the shank, and between the legs of all the staples at once, and thus lifts them off from the bridge over which they were doubled, and conveys them suspended on the blade of this knife to a very curious little machine, which gives them the knee bend. The workman hangs the staples upon a small brass bar, or ruler, fixed in the machine, and then withdrawing his knife, leaves them, and prepares to double another packet of wires. The machine has an axis extending its whole length, which is about eight inches; and this is turned with a regular and equable motion, by the same wheel-work as the common roasting jack; and the workman, from time to time, winds up the handle, to keep it always in motion. The axis has ten small levers, or claws, upon it, at different parts of its length, and opposite to each is one of the rulers, with staples on it always ready to be bent. Each claw does one at once. The rulers being placed rather inclined, the staples always have a tendency to run down towards the axis, but are prevented from falling off the end of it by a knob or projection on the top of the ruler. Over this knob one staple is lifted at every revolution of the axis, by a small detent, called the *kicker*, which lies concealed in a groove in the upper surface of the ruler, like a knife blade in its handle; but is lifted up at every revolution of the axis, and then raises one staple over the stop, and it slips down an inclined plane, or continuation of the ruler, towards the axis. At the bottom of this inclined ruler is a sort of die, or recess, into which the legs of the wire staple fall; and then the claw, or lever, upon the axis coming past, gives the knee bend to the wire, by forcing its point while it is held in the dies, and bending it over a proper rest. The instant the claw has passed by, the spring of the wire causes it to leap out of its die, and make way for another, which is kicked down at the next revolution. Thus every turn of the spindle crooks ten staples; and the workman keeps it constantly supplied, so as to bend an immense number per day. This machine is said to have been invented about 1775, by a Quaker, whose name we have forgotten.

This is the process of forming card wires, as at present practised; but some more complete machines have been invented by ingenious mechanics: One is in use in the neighbourhood of Halifax, in Yorkshire; and another, similar in its properties, is preserved in the repository of the Society for the Encouragement of Arts, &c. London. It was invented by Mr Joseph Beard of Cogeshall, in Essex, who received a reward from the Society of a silver medal and 40 guineas for it, in 1805. This machine displays so much ingenuity, that we requested and obtained permission of the Society to have a drawing made of it, which is given in Plate CXI. Fig. 2. It has not been published in the volumes of their Transactions. The machine is double, having parts to make two complete card wires at once. It receives two wires at once, from two reefs, on each of which a coil of wire is placed. The wires pass between a pair of rollers, by which they are drawn into the machine, which cuts off a proper length from the ends, and bends the pieces into the proper form, then drops them into a drawer beneath, and proceeds with two others. Our draughtsman has found it necessary, for simplicity, to exhibit only one of the halves of the machine, which is by itself a complete machine; and in this division some alterations were necessarily made in the form of some few of the parts, which were in the original common to both halves. This drawing is not, therefore, to be considered as an exact representation of the machine in the Society's possession, though it contains all the essential parts and movements. AA, Plate CXI. Fig. 2. is a main axis, which puts all the parts in motion. It has a flywheel C fixed on the end of it, and is turned round by a handle B; or it might receive its motion from any machinery, by an endless band, or strap and pulley, as it does not require any attendance.

The wire *a a* is conducted from the reel before mentioned to the machine, and first passes over a rest or frame *b*, which has a notch in each of its sides to receive the wire, and to keep it down in these notches. It is also passed through a wire eye or ring *c*, to which a sufficient weight is appended, to cause such a friction as will keep the wire steady. The wire next passes through a guide, formed by a hole in a piece of iron *d*, fixed by screws to a vertical standard G, rising from the iron frame FF, on which the whole mechanism is erected. By the guide *d* the wire is presented to a pair of rollers or wheels D, by which it is drawn forwards. These wheels are exactly of the same size, and, being beneath each other, only one can be seen in the figure. The lower roller, which is hidden, is fixed upon an axis, which extends across the frame, its ends being supported by the joints of the centre screws 20, 20. The axis is turned round by means of a toothed wheel 7 upon the main axis, and acting in another exactly similar to it, fixed immediately beneath upon the axis of the lower roller, which is perpendicular to the main axis; but the teeth of the wheels being both inclined at an angle of 45° to their respective axes, become parallel at the points of contact, and the wheels turn each other round, by a similar action, to the endless screw; from which, however, this mode of communication differs most materially, in the circumstances of the two wheels, or screws, (for they partake of the nature of both) being of equal dimensions and similar forms. This communication causes the lower roller to make a revolution for every one of the main axis. At the opposite end of the axis of the lower roller, a cog-wheel is fixed, and operates upon another E of exactly similar dimensions, and placed over it, so as to conceal the former. This wheel is fixed upon the axis (shewn by dotted lines) of the upper roller D, which is mounted upon the points of the centre screws, held in a frame marked H. This frame is attached to a standard G of the frame by two centre screws, so that it will rise on the points of these as an axis, and thus permit the upper roller to rise and fall, to accommodate itself to the wire, and press it so fast upon the lower roller as to draw it forwards. The pressure is occasioned by a strong spring K fixed on the frame I, and its end hooked beneath a projecting part (not shewn) of the standard G.

The rollers D deliver the wire into a steel tube, *e f*, (see also Fig. 3, where it is shewn separately,) the hole through which being but just large enough to admit the wire, straightens it in the manner of dies, and, together with the rollers, completely takes out any crooks in the wire. The tube, (or pair of dies,) *e f*, is made in two halves, which are held together by the same clamp screw, which fastens them into the bracket L that supports them. The end *f* of the steel dies, which is enlarged, as shewn in Fig. 3, and has a smooth flat face, is the point where the wire is cut off, by means of a small knife *g*, fixed into an axis M, on which is a lever 5, actuated at the proper interval by the lever or claw 4, on the main axis A, into which it is screwed; and can therefore be readily adjusted in length, to operate more or less upon the lever 5, by which it cuts off the wire at the point, where it emerges from the end *f* of the dies *e f*. The length of wire which is advanced through the dies, before it is cut off, is measured by the end of the wire coming up to the flat head of a screw 10, supported by a bracket L; but the instant the wire reaches this, the upper roller D is lifted up, so as to relieve the pressure upon the wire. This is done by a cam 1, which has a part of the frame I projecting over it, and at the end of it is a tooth or knob, fastened by the square nut. This tooth is lifted by the cam 1, which is a circle, having a deep notch cut in it, and thus relieves the wire when the circular part of the cam comes beneath it; and though the motion of the rollers continue, the wire remains stationary, but in turning the notch presents itself beneath the tooth of I. The spring *k* now presses the upper roller upon the wire, which is then pushed forwards until the proper measure is advanced, when the upper roller will be again lifted up by the cam, as before mentioned. This movement is, therefore, devoted to measuring the wire; the rollers and dies *e f* to straightening it; and the shears, or cutter *g*, to cutting it off into the lengths measured by the other. We have now to explain the mechanism for doubling and bending. These parts are in the drawing shewn of their real size, to render them distinct, though all the other parts are only one half the full size. The wire, when advanced by the rollers, is introduced between two pieces of metal *q t*, *r s*. These are shewn in all the figures. In Figs. 2 and 3, they are only represented by small squares; but Figs. 4 and 5, shew them to be the ends of levers *q* and *r*, moveable on one common axis, but independent of each other. They are called the back and front blades of the pliers; their axis of motion is parallel to the main axis A; and is suspended between the points of centre screws, supported by the standards GG. This forms the axis of the lever *r*, as shewn in Fig. 4, which only represents the moving parts. The axis of the lever *q*, marked 15, 15, swings between the points of centre screws attached to a part of the lever *r*, but exactly in a line with the two fixed centre screws on which *r r* itself moves. Thus both blades of the pliers move on the same central line, but independently; they have therefore a motion directly to and from the main axis, but no other. The two levers *q* and *r*, have a small spring 19 (Figs. 4 and 5,) between them, which always tends to separate them and open the pliers. The axis 15 of *q* has a short tail or lever 18 rising from it, which stops against the point of an adjusting screw 16, (Fig. 5,) and determines the quantity of approach which the end of the blade *q* (Figs. 2, 3, and 5,) shall make towards the main axis; 17 is a spring of a semicircular form, always drawing the tail 18 towards the screw 16; and consequently urging the blade *q* towards the main axis; the spring 19, also urges the front blade *t r s*, (Figs. 2, 3, and 5,) towards the axis, till the arm 11 screwed to it, rests upon the outside of the axis.—A cam 9 is fixed on the axis at this part; and when it comes round, acts upon 11, and by it forces the blade *t r s* away from the main axis, till *t* comes in contact with the wire *a a*, (Figs. 2 and 4, and shewn in Fig. 5 by a small black dot surrounded by a white circle,) and presses it against the blade *g*; thus holding it in the manner of a pair of pliers, or a finger and thumb, while the shears cut it off. All this time the blade *g* may be considered as stationary; the spring 17, (Fig. 5,) which opposes its retreat from the main axis, being so much stronger than 19, which opens the pliers; but as the cam 9 turns farther round, it continues to press upon 11, and the front blade with it, against the wire, and by this against the other blade *q*, so as to force the pliers back altogether on their common axis of motion, into the position Fig. 3.

Now the two ends of the wire being supported by the ends of two levers, *h* and *k*, whilst the middle of it is thrust back by the pliers, doubles it, or gives it the form of a staple. The levers *h* and *k*, which are called the side benders, must be explained before this can be clearly comprehended. They have each a motion on their respective centre pins, or axis, 21, 22, fixed in a plate, screwed upon the framing F. These two levers have arms approaching each other, in a direct line from one centre to the other; and where they meet have a tooth *i* on the lever *k*, entering a notch in *h*, and operating in the manner of a cog, to cause any angular motion which is given to one lever to be communicated equally to the other. This causes the ends of *h* and *k*, where they operate upon the wire, to mutually advance and recede from each other, by equal quantities. The motion is given to the benders by a lever *k'*, which is part of *k*, but has no connection with *h*, though it passes over it. To the end of *k'* a rod *l* is jointed, which passes over the axis, and has a stud, or tooth, fastened by the square nut, which is operated on by a cam upon the main axis, and, at the proper interval, draws *l* and *k'*, and thus opens the benders *k* and *h* in the manner shewn in Fig. 2. When this cam passes by, the benders shut or approach each other by the force of a spring *p*. This operates on a lever *n*, which has a pin *o* rising from it, and pressing back a tooth of the lever *h*, giving them a tendency to shut. This they do the instant the cam has relieved the lever *k′*, which retires till it rests against a screw *m*, determining the nearest distance they can approach to each other, as in Fig. 3; and the regulation of the cam, or the tooth of the rod *k*, which it acts upon, (by means of its square nut,) determines the greatest opening they can have, as in Figs. 2 and 4. The ends of the levers *k* and *h*, where they act upon the wire, have notches in them, through which the wire passes in the first instance before doubling. This is shewn in Figs. 2, 4, and 5: *t* and *s* are small plates of steel, screwed at the two sides of the front blade *r* of the pliers forming its faces; over these the wire is doubled by being thrust in between the side benders, which then close together, as shewn in Fig. 3, and also in Fig. 7. In this state, the two legs of the wire being doubled, (in the form of *y*, Fig. 1,) pass, just beneath two shoulders, formed upon the steel blade *s*, Fig. 4, in the manner explained in Fig. 7. These shoulders will, of course, prevent the legs of the wires from rising, and they are bent into the state of Y, (Fig. 1.) by a lever 8, fixed in the main axis, which passes by at the proper time, and raises the points *a a* (Fig. 3 and 7.) so high as to give them the proper quantity of the knee bend. This forms the wire, and when the cams pass by, the pliers and side benders open into the position of Fig. 2, when the card wire drops into a box beneath.

Considering the position of Fig. 3. as the point of commencement, we shall recapitulate the movements of this ingenious machine, to render its operations distinct, and shew the periods of the different parts of the process.

On turning the main axis in such a direction that the handle B (Fig. 2.) descends, the cams act in the following succession:

1. The notch of the cam 1 suffers the roller D to press upon the wire, and thus holding it fast between the upper and lower rollers; which as they turn round,

2. Advance the end of the wire *a a* through the dies *e f*, before the notches in the end of the side benders *h* and *k*, and between the pliers *q* and *t*, *r*, *s*, until the end of it touches the screw 10. At this instant,

3. The cam lifts up the upper roller D, and the friction on the sides of the frame *b* prevents its further advance. This is the state in which Figs. 2, 4, and 5, represent the machines.

4. The cam 9 presses on 11, and forces the blade *r* back, till the side *t* meets the wire; and removing it backwards, holds it fast against the front of *q*, and pinches the wire tight between the two jaws of the pliers; whilst,

5. The cam 4 depresses the lever 5, and by the cutter *g*, cuts off the wire instantly; leaving it held by its middle, between the pliers.

6. The cam 9, continuing its motion, drives back both parts of the pliers together, and the wire with them; its ends being supported by the ends of the side benders, it assumes the bend of the dotted lines in Fig. 2, (though the pliers are not there represented as thrown back.)

7. A notch in the cam of the rod *l* now presents itself, and suffers the spring *p* to close the side benders *h* and *k* together, as shewn in Figs. 3 and 7, which completes the doubling into the form of *y*, Fig. 1.

8. The lever 8 rising, lifts the ends of the wire, and the legs being kept down by the shoulder of *s*, gives the knee bend. The manner of this is shewn by the dotted lines in Fig. 5, though neither the pliers or lever 8 are there in the proper situation to effect this part of the process.

9. All the cams except one relieve their respective movements at once, and the finished wire drops out of the pliers. Thus the cam 4 has, in the interim of the other operations, passed by and suffered the blade *g* to return by the action of its spiral spring 6; the cam of the rod *l*, and lever *k′*, opens the side benders; the cam 9 passes by, and permits the return of the pliers, by the spring 17, (Fig. 5.); but when the tail 18, of the blade *q*, meets its stop screw 16, *q* returns no farther, but the front blade *r* continues to advance towards the axis, by its spring 19, as fast as the cam 9 suffers it. This opens the pliers, and the wire falls out.

The notch of the cam 1 now comes round, and suffers the roller D to descend on the wire, and advance another portion, which is treated in the same manner as the first. These operations succeed each other with such rapidity, when the machine is in action, that the handle may be turned at the rate of 150 times per minute, without in the least injuring its operation; and the power required to turn it is so small, that one person might turn a dozen. or if they were turned by a mill he could attend a greater number, as they very seldom do wrong, or make a false wire.

The machine is capable of making wires of any size, by the following adjustments:

1. The length of the notch in the cam 1, regulates the length of the wire which shall be cut off, because it is only as long as this notch is presented to the lifting tooth of the frame I, that the rollers act upon the wire. The screw 10 is adjusted to stop the wire when sufficiently advanced; but this is only a precaution, to prevent any accidental protrusion after the cam 1 has lifted the upper roller. The cam 1, as before stated, is a circle; and to have the means of adjusting the length of the notch in it, the cam is made of two equal circles, or wheels, fitted on the main axis, and applied to each other, side by side, so as to make one. The back of the frame I, which rests upon their circumference, is as broad as both circles together. Each has a notch cut in it much wider than the notch in the cam is ever intended to be.

Now if these circles were twisted round on the axis, so that the notch in one circle is applied opposite to the complete part of the other, the cam would act as a complete circle, and the tooth of 1 would never drop into the notch of either, because the circumference of the other circle holds it up at the time. On the other hand, by placing the two notches opposite to each other, the rollers would be suffered to act upon the wire longer than is ever intended. Therefore between these two extremes, the limits of the notch may always be determined by trial, that the proper length of wire shall be protruded, one circle making the beginning, and the other the end of the notch in the cam. Both are fastened on the axis by clamp screws.

2. The centre screws, on which the whole of the pliers *r r* (Fig. 4,) are suspended, admit of adjusting them, so that their blades shall seize the wire by the middle, and make the ends of the staple equal when doubled.

3. The steel faces *t* and *s*, of the blade *r* of the pliers, can be removed, and any other substituted. This regulates the distance between the legs and points of the card wire, or the length of its shank.

4. The screw *m* determines the degree of closure the side benders shall have; and the square nut on the rod *l*, (which attaches to it the piece on which the cam operates,) determines the distance to which they will open. This is of consequence, for the wire, if bent too sharply at once into the dotted position, (Fig. 2,) might be cut or broken, instead of bent fairly.

5. The screw which fixes the lever 8 into the main axis, admits the lever to be set farther out, and then it will give a greater degree of knee bend, or if nearer the axis will bend less. This is also influenced by the quantity of motion the cam 9 gives to the pliers, which can be adjusted by sliding the curved piece 11 up or down the lever *r*, for which purpose its screws are fitted in grooves. This causes a more or less protuberant part of the curve 11, to meet the cam *q*. The screw 16, as before stated, adjusts the blade *g* of the pliers.

The wires being thus crooked, either by hand or by machinery, are to be stuck through the leathers, in which holes are pricked for their reception. This was formerly executed by the tedious process of pricking with a double awl, but now it is done by machines; one kind adapted to the sheet cards, and the other for filleting. The former consists of a square wooden frame, like a table without the top board. In this a square frame or carriage slides horizontally, and has cross bars, provided with jaws to fasten, and screws to stretch the sheet of leather with a proper degree of tension. A cord is fastened to one end of the carriage, and passing over a pulley, has a weight attached to it, which always urges the carriage one way. It has a rack fastened to one side of it, the teeth of which are engaged by the worm of an endless screw, formed at the end of a long axis, placed parallel to the direction of the motion of the carriage, which is also parallel to the rack. The endless screw is prevented from running round, as it would do, by the weight drawing the carriage by a cylindrical brass wheel, the circumference of which has several circles traced upon it, each divided into a different number of divisions, and marked by small holes. A spring with a tooth, or pin at the end, applies to these divisions, in the same manner as the dividing plate of a wheel-cutting engine. Now, by lifting the spring tooth out of any division, the weight operating upon the carriage draws it forwards, the teeth of the rack turning the endless screw about till another division comes to the tooth which drops into it, and holds it fast till the workman again relieves the spring catch. By this means the carriage and the leather is moved an equal quantity at every time, to measure the distance at which the rows of holes shall be pricked; and this measure can be altered at pleasure, by using a different circle of divisions. The holes are pierced by a double row of prickers, as long as the sheet of leather. They are small steel points fixed into a piece of iron, which is screwed to a strong frame, moving on two centre screws, forming an axis for it immediately over the leather, and in a direction across that of the motion of the carriage. On this axis the frame rises and falls in the manner of a book lid, when moved by a long handle (lever) which is fastened to it. The row of points being fixed parallel to the axis, forms a double row of holes, when the lever is pressed down, in a direction across the motion of the leather. A proper bed is prepared beneath the leather, just where the points act, to support the sheet while it is pierced. This machine is used as follows: A sheet of leather is prepared by rubbing the grain side with soap, and sizing over the flesh side. It is then fixed to the two cross bars of the carriage, by the jaws which bite its edge fast; and by the two screws first mentioned, the sheet is strained very tight. All this time the lever and pricker frame is turned up out of the way; and the end of the lever being suspended from the ceiling, but the leather being fixed, the workman adjusts the carriage to the proper point of commencement, and then strikes down the end of the lever, pricking one double row of holes across the whole length of the sheet; he then lifts up the lever, and, taking the spring catch of the dividing cylinder in the other hand, lifts its point out of a division, suffering the carriage to move till the next division comes to the catch; then he strikes down the lever, and pricks another double row, and at the same time that he lifts it up again he suffers another division to pass by; and in this manner the operation proceeds with great rapidity, till the whole sheet is finished. The pricker, it should be observed, is provided with a double row of points, and pierces two rows at once, that the points of one may fall opposite the spaces of the next row; a condition which it would be difficult to effect by other means than piercing two at once.

The fillet cards are pricked by a different machine. In this the pricker frame is moved by a crank, on a spindle parallel to its axis of motion, and turned with a band and fly wheel, to give it a rapid motion. The fillet of leather is wrapped round a roller fixed in the frame of the machine, and provided with a pulley and cord, to which a weight is suspended, acting to wind the leather upon the roller; and therefore when the fillet is forcibly drawn off the roller, this weight acts to keep the leather to its proper degree of tension. The fillet is drawn forwards by a pair of rollers, between which it passes, and they are pressed together by a spring, with a sufficient power to hold the leather fast between them. They are turned round by a detent at the end of the main spindle, which moves the wheel one tooth at every revolution; and by turning the rollers, advances the leather a proper quantity to receive another double row of pricks, which it does from the pricker frame when it is moved by the crank before mentioned. The pricker frame, except in size, is the same as the machine before mentioned.

The wires are put into the leather by women, who first enter them into the holes, and then push them home by a thimble. Some can put in two wires at once; but this requires a degree of dexterity which very few can attain. The filling the leathers is a very serious portion of the whole labour of card making, and has therefore attracted the attention of mechanics to perform it by machinery. We have seen a model of a very ingenious machine, invented by Mr James Fryer of Rastrick, near Huddersfield, Yorkshire, which pricked the leathers, and at the same time put in the wires, previously doubled in the usual way; but the knee bend was given to them by the machine after being stuck through the leather. This machine has not yet been brought into practical use.

We have received information of a very surprising card wire machine used in America, invented by Mr Amos Whittamore. It completes the whole operation at once, cutting and doubling the wires, pricking the leather, and sticking them in, and then giving the knee bend to them afterwards. It does one wire at a time; but acts with such rapidity, as to complete four per second; so that the whole labour by this machine is less than any one operation in the common way. The following extract of a letter from the proprietor of these works, William Whittamore of West Cambridge, to the collector of Boston, dated 24th of November 1809, was published in the American minister's report on the manufactures of the United States, and gives some account of this manufacture.

"The machines with which we now manufacture all kinds of wool and cotton cards that have been called for, were invented by Amos Whittamore in 1797; he then obtained the exclusive privilege of using the said machines by letters patent, for fourteen years. Amos Whittamore and myself were jointly concerned in the first machines that were built, and are still the sole proprietors of the patent. Congress at their last winter session extended the patent fourteen years, by a special act. We have fifty-five of those patent machines, thirty-seven of which are now in use. These machines, with the other apparatus necessary to carry on the business to its present extent, have cost us about forty thousand dollars.

We have now employed in the factory upwards of forty hands. We manufacture weekly one hundred and eighty dozen pair of hand cards, and two hundred square feet of cards for the woollen and cotton factories, which together amount to about two thousand dollars. Had it been in our power the year past to have supplied ourselves with card wire, the amount of the cards manufactured in our factory would have exceeded three thousand dollars. Fifty thousand dollars at least, is necessary for a capital to carry on the business to this extent, exclusive of buildings and machinery. We have been obliged to make great sacrifices to obtain money to enable us to carry on the business, so as to be able to answer the demand for cards. Our monied institutions have afforded but little support to domestic manufactures. The wire is the only article necessary to the manufacture of cards, but what our own country produces, and that might be manufactured here as good, and nearly as cheap, as in England. Of this we have so far satisfied ourselves, (by experiment,) that nothing but want of capital has prevented us from setting up that business. The iron made on Lake Champlain is found to be as good for wire, if not superior, to any ever imported. The wire to supply our factory one year, will, in England, cost about fifteen thousand dollars, and the expences of importing, about ten per cent., (it being free of duty.) Perhaps about the same quantity is used annually in the other card manufactories in the United States. There is no doubt in my mind, from the observations made since I have been in the manufacturing business, that had the same support been afforded manufacturers generally, that has been made to trade and commerce, our manufactories at this time would have been carried on much more extensively, and would have generally afforded a profit to those concerned. Since the obstructions to our foreign trade, the manufactures of our country have increased astonishingly. The demand for wool and cotton cards, during the present season, has been twice as great as it has been during any preceding year. We hear that Mr Joseph Dyer has, in conjunction with the inventor, recently taken out a patent in England for this invention, which will most certainly supersede all the other machines that have been contrived for this purpose." (J. F.)

CARDAMINE, a genus of plants of the class Tetradynamia, and order Siliquosæ. See BOTANY, p. 257.

CARDAMOM. See MATERIA MEDICA.

CARDAN, JEROME, a celebrated Italian mathematician and medical writer, was born at Pavia on the 24th of September 1501, and appears to have been the natural son of a celebrated advocate and physician at Milan. When he was only four years old, he was sent from Pavia to Milan, where he was instructed by his father in mathematics, astronomy, and judicial astrology; and in his eighth year, when he was afflicted with a dangerous illness, his father devoted him to St Jerome. In the year 1521, he went to study medicine and philosophy at the university of Pavia, and two years afterwards he was able to give lessons on mathematics. In 1524, he went to Padua, where he received in the same year the degree of master of arts; and in the year following, he was honoured with his medical degree. He married about the end of the year 1531, and, contrary to his expectations, he had several children.[*] Having refused a medical chair in the university of Pavia, he was, in 1533, appointed to the professorship of mathematics at Milan, and at the same time he commenced the practice of the medical profession. In 1539, he was admitted a member of the college of physicians in that city; and though he was thus brought into notice, his time seems to have been more occupied in writing books than in attending patients. His work *De Malo recentiorum Medicorum medendi usu*, Venet. 1536, and his *Contradicentium Medicorum Libri duo*, Lyons, 1548, in which he censures the practice of his contemporaries, and points out the inconsistencies and contradictions of which the best writers have been guilty in their account of diseases, seem to prove that he was not on very good terms with the other physicians in Milan. In the year 1543, he gave public lectures in medicine at Milan, and in the following year he repeated them at Pavia; but as he could not procure payment of his salary, he discontinued them at the end of a year, and returned to Milan.

Upon the recommendation of Vesalius in 1547, the King of Denmark offered Cardan a professorship in the university of Copenhagen, with a free table, and a salary of 800 crowns a year; but Cardan declined this offer, on account of the severity of the climate, and the religion of the country.

Archbishop Hamilton, the primate of Scotland, and the regent's brother, having been severely afflicted for ten years with an asthma, applied for relief to the physicians of the French king and of the emperor of Germany, but as he received no benefit from their prescriptions, he sent for Cardan in the year 1552. At the end of 75 days, Cardan left the archbishop in a state of convalescence, and gave him such prescriptions, that he was completely cured at the end of two years. Larrey, in his history of England, informs us, that when Cardan was taking leave of the primate, he remarked that though he had nearly cured him of his malady, yet he could not change his destiny, and prevent him from being hanged. After receiving the most liberal remuneration for his services, Cardan returned to Milan at the end of ten months by the way of London, the Low Countries, and Germany; and during his stay at London, he is said to have calculated the nativity of Edward VI. Having resumed his former employments of practising medicine and teaching mathematics, he continued at Milan till the end of October 1559, when he went to Pavia to fill the professorship of medicine; and in the year following, he accepted a similar office at Bologna. In this situation he continued till the year 1570, when he was thrown into prison for some offence with which we are not acquainted. At the end of some months, however, he was permitted to confine himself in his own house, and as soon as he obtained his liberty, which was in September 1571, he repaired to Rome. Here he lived for some time without any public employment; but he was soon chosen a member of the college of physicians, and received a pension from the pope, which was continued till the day of his death, which happened on the 28th September, 1575.

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[*] "Cum Sol et maleficæ ambæ et Venus et Mercurius essent in signis humanis, ideo non declinavi a forma humana, sed cum Jupiter esset in ascendente, et Venus totius figuræ domina non fui oblæsus nisi in genitalibus, ut a xxi anno ad xxxi non potuerim concumbere cum mulieribus, et sæpius deflerem sortem meam cuique alteri proprium invidens." Cardanus *De Vita Propria*, cap. ii. p. 8.

Cardan was perhaps one of the most singular characters that has appeared in any age or country. In the account which he published of his own life, he has, with great ingenuousness, given a full detail of his good and bad qualities, though it is probable that he has suppressed many facts which were by no means favourable to his moral reputation. He gravely informs his readers, that he had frequently determined to put himself to death; that he often wandered all night in the streets; that he took the greatest delight in bringing forward subjects that were disagreeable to the company; that he introduced every topic, whether it was connected or not with the subject of conversation; that he ruined his family and his reputation by playing for whole days at games of chance; and that he staked even his furniture and his wife's jewels.

At a time when astrology was in the zenith of its glory, it was natural that Cardan should follow the example of the most distinguished of his contemporaries; but though we find in the character of the times a sufficient apology for his devotion to judicial astrology, yet we seek in vain for any palliation of that empiricism and imposture, which he seems to have systematically pursued during the whole of his life. He who could seriously believe that he had the power of foretelling future events both in his dreams, and from particular marks upon his nails, must have been utterly devoid either of reason or intelligence; but he who could commit such pretensions to writing, and try to impose upon posterity the same delusions which he had practised upon his contemporaries, must have possessed a mind destitute of every honourable feeling, and so deeply in love with falsehood as to deceive when nothing could be gained by the deceit. Cardan, indeed, seems to have been the most determined impostor of his times. He ascribed the extravagance of his opinions, and the eccentricities of his conduct, to the influence of the celestial bodies. He had the audacity to calculate the nativity of our Saviour; and having foretold the time of his own decease, he is said to have starved himself to death, in order to verify the prediction.

The irregularities of conduct into which Cardan was continually hurried, by the violence and caprice of his temper, became the source of great misery and distress; and the vices and misfortunes of his children, filled up the measure of his suffering. His eldest son married a woman who possessed neither character nor fortune; and having killed her by poison, he was condemned to death, and executed in the prison at midnight. This distressing event produced a deep impression upon the mind of Cardan, who endeavoured to justify the murder on the ground of the wife's infidelity, and who maintained that the vengeance of heaven had followed the judges who pronounced sentence upon his son. His other son was also an abandoned character, and his father was under the necessity of throwing him into prison, and of cuting off one of his ears, and disinheriting him. The payment of his daughter's dowry, and the circumstance of her having no children, were the only distresses which she occasioned.

From such a degrading picture, it is pleasing to turn to those marks of genius and talents by which Cardan has perpetuated his name. As a philosopher, he is entitled to no praise, and as a medical writer he is chiefly famed for his industry and fidelity in the collection of facts. The philosophical speculations which he has published in his works *De subtilitate* and *De Varietate rerum*, are the mere ravings of an unfettered imagination; and if arguments were wanting to prove that Cardan laboured under a partial insanity, we should appeal to these works, as well as to the whole of his conduct.

As a mathematician, however, the merits of Cardan are beyond all praise. In the year 1589, he had completed nine books on arithmetic, algebra, and geometry, under the title of *Liber Artis magnæ;* and when it was nearly printed, having heard accidentally of Tartalea's discoveries in cubic equations, he was extremely anxious to obtain these discoveries for insertion in his work. Cardan first applied to Tartalea through the medium of a bookseller, and, along with the most flattering compliments, he sent him a number of questions to resolve. Tartalea, however, refused to disclose his rules, which Cardan again attempted to obtain from him by personal correspondence. Finding every effort unsuccessful, Cardan at last endeavoured to gain by cunning what he could not acquire by the most urgent supplication. He wrote to Tartalea, that he had recommended him to his particular friend and patron the Marquis del Vasto, who was very anxious to see him; and he invited him to spend a few days with him at Milan, accompanying the invitation, however, with a distinct notification, that such a visit might be useful to Tartalea, and that it would be dangerous to offend the Marquis by a refusal. More intimidated by the threat, than allured by the invitation, Tartalea set out for Milan; but as the Marquis had gone to Vigevano before his arrival, he was induced to spend three days with Cardan till the Marquis should return. Cardan employed every artifice to obtain from his guest the secret for which he so ardently longed. "I shall swear to you," says he, "on the holy evangelists, and by the honour of a gentleman, not only never to publish your inventions, if you reveal them to me; but I also promise to you, and pledge my faith as a true Christian, to note them down in cyphers, so that after my death no other person may be able to understand them." To these protestations Tartalea replied, "If I refuse to give credit to these assurances, I should deservedly be accounted utterly void of belief, but as I intend to ride to Vigevano to see his excellency the Marquis, as I have been here now these three days, and am weary of waiting so long; whenever I return, therefore, I promise to shew you the whole." Cardan, however, having renewed his entreaties to obtain the rule before the departure of his friend, Tartalea replied, "I am content; but you must know, that to be able on all occasions to remember such operations, I have brought the rule into rhyme; for if I had not used that precaution, I should often have forgot it; and though my rhymes are not very good, I do not value that, as it is sufficient that they serve to bring the rule to mind as often as I repeat them. I shall here write the rule with my own hand, that you may be sure I give you the discovery exactly." These verses contained the rule for the three cases

$$x^3+bx=c$$
$$x^3=bx+c$$
$$x^3+c=bx$$

Tartalea reminded Cardan, at parting, of his obligation to secrecy; and during a subsequent correspondence, in which the latter proposes some difficulties in the solution of cubic equations, Tartalea displays the greatest suspicion that Cardan would betray the secret, and never fails to remind him of the vow which he had made.

Notwithstanding all these promises so solemnly made, and so frequently repeated, Cardan published in the year 1545, his tenth book, which contained the whole doctrine of cubic equations, and of course the substance of the rules which he had received from Tartalea. He acknowledges that Tartalea gave him the rule, but without the demonstration, and he asserts, (see cap. xi.) that by the help of the rule alone he discovered the geometrical investigation. Tartalea complained bitterly of this violation of his promise; and Cardan defended himself on the ground, that he greatly extended the method of Tartalea, and was therefore entitled to publish his own improvements. A controversial correspondence was carried on between the two mathematicians with the greatest acrimony, till it was terminated by the death of Tartalea in 1557.

Though Tartalea is certainly entitled to the high honour of originality, yet Cardan has the merit of having prosecuted the subject of cubic equations with singular assiduity and success. His tenth book contains rules for all the forms and varieties of cubic equations, with their geometrical demonstrations; and in every part of it he shews himself eminently skilled in the various branches of algebra. Dr Hutton* has given a very full and interesting analysis of Cardan's work, and a list of his analytical improvements, to which we must refer our readers for farther information on this subject.

The writings of Cardan, which are extremely numerous, were collected into ten volumes folio, and published at Lyons in 1663. Many of them are hasty productions, which were printed only to relieve his pecuniary wants.

The following is a complete list of the different works of our author.

Liber de vita propria. Ephemeris de libris propriis. De Socratis studio. Oratio ad Cardinalem Alciatum. In Thessalum Medicum Actio secunda. Encomium Neronis. Encomium Podagræ, et Mnemosynon. De Orthographia. De Ludo aleæ. Dialectica. Contradictiones Logicæ de uno. Hyperchon. Norma vitæ consarcinatæ, Sacra vocata. Proxeneta, seu de Prudentia civili. De Præceptis ad filios. De optimo vitæ genere. De Sapientia. De summo bono. De Consolatione. Dialogus Hieronymi Cardani et Facii Cardani patris. Dialogus Antigorgias, seu de recta vivendi ratione. Dialogus Tetim, seu de humanis consiliis. Dialogus de Morte, seu Guglielmus. De Minimis et propinquis. Hymnus ad Deum. De utilitate ex adversis capienda. De Natura. Theognostôn libri V. *De Immortalitate animarum. De Secretis. De Gemmis et Coloribus. De Aqua. De Vitali Aqua, seu Æthere. De Aceti Natura. Problematum Sectiones* VII. *Discorso del Vacuo. Se la qualita può trapassare di subjetto in subjetto. De Fulgure. De Subtilitate. Actio prima in calumniatorum librorum de Subtilitate. De Rerum Varietate. De Numerorum Proprietatibus. Practica Arithmeticæ. Computus minor. De Regulis Algebraïcis. Liber artis magnæ. De Aliza Regula. Sermo de plus et minus. Exæreton Mathematicorum Encomium Geometriæ. Operatione della Linea. De Proportionibus numerorum, motuum, ponderum, sonorum. Della Natura de Principii e Regole Musicali. De Restitutione temporum et motuum cælestium. De Providentia ex anni constitutione. Aphorismorum Astronomicorum Segmata* VII. *Commentarii in Ptolomæum, de astrorum Judiciis. De septem erraticarum stellarum Viribus. De Interrogationibus Libellus. De Judiciis geniturarum. De Exemplis centum geniturarum. Liber duodecim geniturarum. De Revolutionibus. De Supplemento Almanach. Somniorum Synesiorum Libri. Encomium Medicinæ. De Sanitate tuenda. Contradicentium Medicorum libri* X. *De usu ciborum. De Causis, Signis, ac Locis morborum. De Urinis. Ars curandi parva. De Methodo medendi. De Radice China. De decoctis magnis. De Sarsaparilla. De Oxymelitis usu in pleuritide. De Venenis. Commentarii in librum Hippocratis, de Alimento. Commentarii in librum Hippocratis de Aëre, Aquis, et Locis. Commentarii in Aphorismos Hippocratis. Conclusiones Lapidibus Galeni, in explicatione Aphorismorum. Apologia ad Andream Camutium. Commentarii in librum Prognosticorum Hippocratis. Comment. in librum Hippocratis, de Septimestri Partu. Examen XXII. ægrorum Hippocratis in Epidem. Consilia varia. Opuscula Medica Senilia, sive de Dentibus liber* V. *seu de Morbis articularibus. Floridorum Libri, sive Comment. in Principem Hazen. Vita Ludovici Ferrarii et Alciati. De Arcanis æternitatis. Politicæ, seu Moralium, liber* I. *Elementa Linguæ Græcæ. De Inventione. De Naturalibus Viribus. De Musica. De Integris, Tractatus Arithmeticus. Expositio Anatomiæ Mundini. Commentarii in libros Hippocratis de Victu in acutis, et in libros* II. *priores Epidem. ejusdem. De Epilepsia. De Apoplexia. De humanis civilibus Successionibus. De humana Perfectione. De Admirandis. De Dubiis naturalibus. De Rebus, Factis raris, et Artificiis. De humana Compositione naturalium. De Mirabilibus morbis et Symptomatibus. De astrorum et temporum Ratione et Divisionibus. De Mathematicis quæsitis. Historiæ lapidum metallicorum, et metallorum. Historiæ animalium. Historiæ plantarum. De Anima. De Dubiis ex Historia. De clarorum virorum Vita et Libris. De hominum antiquorum illustrium Judicio. De usu hominum, et dignotione eorum, tum cura, et errore.*

See Naudeus *Judicium de Cardano*; Haller's *Biblioth. Med. Practic. &c.*; Eloy's *Dict. Historique*; Tessier *Eloges des Hommes Savans*, p. 97; Bayle's *Dict.*; Montucla's *Hist. Mathemat.* vol. i. p. 591; Hutton *Mathemat. Dict.* ALGEBRA, p. 68. (*o*)

CARDIFF, or CAERDYFF, the county town of Glamorganshire, in South Wales, was first built in 1080. It derives its name from the river Taff, which runs along the west side of it, having a bridge of five arches, and falls into the Severn about three miles below the town. It is pleasantly situated on a fertile flat. Its streets are spacious, and its houses well constructed. It consists of two parishes, St Mary's and St John's. There is, however, only one church for both; St John's church having been, with many other edifices, destroyed by inundations of the river in 1607. The high tower of St Mary's church, which was erected in the reign of Edward III.

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* *Mathematical Dictionary*, art. ALGEBRA, p. 68.

is of light appearance and elegant workmanship, having open corners and lantern pinnacles. There were anciently four religious houses in Cardiff: a Benedictine priory, and black, grey, and white friars. There is nothing left of all these except a few remains of the white friars, and the ruins of the black friars, which now afford shelter to some poor fishermen. Formerly the town was encompassed with walls, which were flanked with watch-towers 1280 paces in circumference, and had gates at the four cardinal points. Of these some traces are still visible. The castle, which is the chief object of attention to a traveller, was built in 1090, by the conqueror Fitzhamon, a Norman, after he had taken possession of the country of Morgannoc; and is remarkable in history, principally, as having been the scene of the long imprisonment, cruel treatment, and death of Robert, Duke of Normandy, brother to Henry I., and as having sustained a siege by the parliamentary forces, who took it from the Welsh loyalists in 1645. It stands on the north side of the town wall; is a large stately edifice; was originally of great strength; and is said to have covered no less than eight acres of ground. Though a great part of the ruin has been barbarously pulled down, for the purpose of erecting houses in the town, the present possessor, the Marquis of Bute, has been careful to repair and modernise what remains of it. The entrance into it is bold, having two portcullisses and massy gates. In the inside of the wall, around its whole extent, there is a high terrace; and on the keep, which stands in the centre of the inclosed area, there is a tower, which is of an octangular form, and very handsome.

Vessels of 200 tons can come up to the town; but the principal harbour, called Pennarth, or the Bear's Head, is three miles below it, and adds greatly to the consequence of Cardiff itself, as well as affords shelter to those ships which are detained in the Bristol Channel by westerly winds. The inhabitants of the town and neighbourhood send great quantities of corn, butter, and poultry, to the Bristol market. Nearly 9000 tons of cast and wrought iron are annually exported to London and other places; and the conveyance of this ponderous article has been greatly facilitated, by a canal cut from Pennarth Point to Cyfartha iron-works, carried with much ingenuity through a mountainous country to the extent of 25 miles, and subsequently improved by a branch which goes off to other works at Aberdare. No less than 30,000 boxes of tin-plates, which are manufactured at a place called Melyn Griffin, about four miles distant, are annually sent off for Bristol; and the scropes of iron-plate, from which the tin is made, are converted into bolt-iron for ship-building, and form another considerable article of exportation in the trade of Cardiff.

According to the return made in 1801, it contains 327 houses, and 1870 inhabitants; and of these, 213 are stated to be engaged in trade and manufacture. By the return of 1811, its population amounted to 2457. It is an ancient corporation, governed by the constable of the castle, two bailiffs, twelve aldermen, twelve capital burgesses, &c.; and along with Cowbridge, Swansea, Longher, Aberavon, Kenfig, Neath, and Lantrissent, sends one member to parliament. Here a court of record is held every fortnight; and the assizes for the county meet in April and August. There are two weekly markets, on Wednesdays and Saturdays, which are well supplied: Those held in the second Wednesdays in March, April, and May, are very large. And there are fairs for horses, cattle, &c. on June 19, Sept. 19, and Nov. 30. See Evan's *Tour in South Wales*; and Barber's *Tour in South Wales*. (τ)

CARDIGAN, called by the Welsh *Abertivy*, is the county town of Cardiganshire, in South Wales. It is situated on a steep bank, and about two miles from the mouth of the river Tivy, over which there is a stone bridge of five arches, that leads into Pembrokeshire. The river is navigable here for vessels of 150 tons, and there is a tolerably good key for loading and unloading, though a dangerous bar, which lies at the mouth of the river, must ever prevent the town from becoming a great commercial place. At the commencement of the war, Cardigan had a considerable export trade to Ireland and other places, in lead and corn, of which last article it annually shipped off from 50,000 to 100,000 bushels; but at present, the commerce in which it chiefly engages, and on which it chiefly depends, is furnished by the iron-works in its vicinity. In 1801, it contained 415 houses, and 1911 inhabitants, of whom not more than 200 were employed in trade and manufactures. In 1811, the population was 2129. It is governed by a mayor, a recorder, twelve aldermen, and thirteen common councilmen; and, in conjunction with the outlying boroughs of Aberystwith, Lampeter, and Adpar, sends one member to parliament,—the number of voters amounting to about 1200. Though the houses and shops are on a small scale, yet, upon the whole, the aspect of the town is pleasing. At the same time, considering that it is the capital of the county, it has an air of poverty in it. The principal public buildings are, the *church*, which is a stately edifice; the *town hall*, where the assizes are held, which has a good appearance; and the *county gaol*, which was erected in 1797, and is sufficiently commodious. Cardigan was anciently surrounded by a wall; and near the bridge are the ruins of a castle, which seems to have been a spacious structure. It is said to have been built by Gilbert de Clare in the time of Henry II.; and Powel affirms, that it was built for the purpose of defending the borders. In 1164 it was besieged, taken, and razed to the ground by Rhys Gryffyd.—Cardigan has a market for ordinary purposes on Wednesday and Saturday; and four fairs annually, viz. on February 18, and April 5, for horses, pedlars' ware, &c. and on September 8, and December 19, for black cattle, &c. See Malkin's *Scenery, Antiquities, &c. of South Wales*, vol. ii.; Evans' *Tour through South Wales*; and Lipscomb's *Tour, &c.* (τ)

CARDIGANSHIRE, in Welsh *Swidh Aberteini*, or *Sir Abber Teivi*, a county in South Wales. It anciently formed one of the six parts into which the kingdom of Wales, called Dinevowr, was divided, and contained four cantrefs and ten comots: (See Enderbie's *Cambria Triumphans*, p. 214.) It is bounded on the north by Merionethshire, on the west by that part of St George's Channel called Cardigan Bay, on the south by the counties of Caermarthen and Pembroke, and on the east by those of Radnor and Brecknock. The western side of it has suffered great depredations from the sea. According to tradition, an extensive tract of land has been swept away; and, instead of many flourishing towns, there now remain only a few miserable villages. Some have supposed, that the whole of Cardigan Bay was formerly a spacious plain, on which the sea made gradual encroachments, till its progress was stopped by the elevated ground which now encircles the shore; and the appearance which the scene exhibits, together with the common opinion that prevails among the people, renders this supposition extremely probable.

This county may be divided into two districts, the lower and the upper. On the more elevated grounds of the lower district, the soil is in general a light sandy loam, varying in depth from four inches to a foot, and having for its substratum a slaty kind of rock. In the valleys it is very deep, and, with a few exceptions, very dry. The manures made use of are dung, lime, and marle. Tolerable crops are raised of wheat, barley, peas, black oats, and potatoes. Turnips also are cultivated to some extent, and rich fields of clover and natural grass are occasionally to be seen. But the mode of farming is, on the whole, injudicious and slovenly; and, consequently, the produce is in very few cases so abundant as might be expected from the goodness of the climate, and the quality of the ground. It is a singular fact, that there is a good deal of land on the sea coast from which crops of barley have been annually taken for at least sixty years past, without any diminution either in the quantity or quality of the produce. The manure employed is sea-weed; and the grain is accounted so excellent, that it is sent to the adjacent counties for seed-corn. The farmers all keep cows for the purpose of breeding; and also of making butter and skimmed milk cheese,—the former of which is chiefly for exportation, and the latter solely for home consumption. The black cattle are of the Pembrokeshire breed: they work, travel, and fatten well; and used to be favourites of the English drovers, who bought them readily, and at good prices. These are kept by the few who sow turnips. Their number is diminishing, because a spirit for inclosing prevails, and they are reckoned enemies to the growth of young hedges. This is surely unwise, as the soil is so well adapted to them, and as the evil which they occasion might be easily prevented.

The upper district, comprehending chiefly the northern and eastern parts of the county, is very mountainous. A great proportion of it is bleak and barren; but much of this is owing to want of judicious enterprize and agricultural skill, as well as to natural sterility and unfavourable situation. In the vallies and dips, which are narrow, and of no great extent, the soil is chiefly of a stiff retentive clay; in the declivities it has an admixture of light loam; and on the high grounds it is uniformly thin and excessively poor, yielding little except ling, heath, and moss. The farmers here depend more on their stock than on cultivation. They scarcely raise a sufficient quantity of corn for their own consumption; and pay their rents principally by the profits derived from the sale of cattle and horses bred by themselves, and of sheep, which they have in pretty numerous flocks. The breed of black cattle is much the same with that of Pembrokeshire and Caermarthenshire. They are small, but well made and hardy, and answer much better for the butcher than the dairy. Formerly all England to the south of the Trent was supplied with black cattle from this quarter; and it is still looked to by dealers and drovers as a kind of nursery for these animals. The native unmixed breed of sheep are very small, long legged, narrow on the chine, of various colours, some with horns, and many without them. There are also a good many pigs reared. These, indeed, always form a part of the farmer's stock, though they are not found to be a very profitable concern. In the south east of this division there are some pieces of ground inclosed, and well cultivated; and there is a larger portion of good pasture and meadow here than is generally to be found in the neighbourhood. The kinds of grain produced in the upper district are the same as those produced in the lower, with the addition of rye, which is raised here in considerable quantities. The waste lands in Cardiganshire are very extensive. Including those tracts which are but partially cultivated, they may be estimated as amounting to nearly the half of the county. A large proportion of them, however, if not fit for the plough, might be planted with great advantage. Indeed, improvements of this kind have been already set on foot, and are advancing with a rapid progress. The climate is mild and temperate, varying a little according to the elevation of the ground, the distance from the sea, and the state of cultivation; not so cold as in the midland counties, nor so humid as in the western coasts of England; and, upon the whole, favourable both to health and husbandry. Cardiganshire used to be considered as so barren and unproductive, that it was proverbially called by the people of the neighbouring counties, the *Devil's Grandmother's Jointure*. But it is gradually falsifying that reproachful appellation; and though it can never, perhaps, vie in fertility with regions that have been more favoured by nature, it promises soon to hold a respectable place among those districts which are distinguished by agricultural improvements. The principal ground of hope rests in the institution of an Agricultural Society, consisting of the most intelligent gentlemen and farmers in that quarter, which has already done a great deal of good, and from which a great deal more is to be expected; because, according to Mr Malkin, it is formed "on a better plan, and founded on more rational principles than that of any county in South Wales."

The principal rivers in this county are the Tivy, the Rydol, and the Ystwith. The Tivy, which forms the greatest part of its southern limit, rises out of one of the many small lakes which are collected in the hollows on the eastern side. It runs over a very rocky and irregular channel till it reaches Ystrad Flwr, when it assumes a more settled course, and, passing by Landbeder, at the border of Caermarthenshire, becomes from thence the boundary between the two counties, till it falls into the Irish sea, about two miles below Cardigan. The Rydol rises on the south-west side of Plynlimmon, and, after running south and south-west, discharges itself into the Irish sea near Aberystwith. The Ystwith has its mouth, as the name of the town denotes, at the same place with the Rydol, though it takes its rise from among the hills in the eastern district. Beside these, there are some streams of smaller consequence; and, as might be expected from the nature of the country, a vast number of rivulets. Indeed, the authors of the Agricultural Survey tell us, that, "exclusive of springs upon the hills, there is no valley without a river or a brook; and scarcely a glen, or what we call a dingle, without a stream sufficient to turn a mill." These must be considered as great advantages, both for watering the soil, where irrigation may be useful, and for driving corn mills and other kinds of machinery. At the same time, they are frequently productive of much injury. Though, in dry weather, these rivulets are very inconsiderable, yet, after storms, or continued rains, they become formidable torrents,—rush with terrible impetuosity through the deep narrow chasms that are formed by the hills,—are precipitated sometimes in the form of tremendous cascades,—bear away before them every thing that lies in their way,—and even tear up the fertile soil of the vallies, substituting in its place nothing but barren gravel and stones.

There is a great want of fuel in this country. Coals are scarcely to be had, except at a high price, being all brought from a great distance by sea. Of wood there is but little, and in many places that little is much neglected; though in other quarters, particularly in the neighbourhood of Hafod, considerable tracts of land have lately been laid out in plantations, which promise to be both profitable to the proprietors, and useful to the country. Various kinds of trees have been planted, but those which seem to thrive best are the larch and the beech. The most prevalent species of fuel is peat. There are many extensive tracts producing it, such as the plain between Tregaron, and Strata Florida or Stratflour, and that part of the coast beyond Aberystwith which borders on the river Dovy. These are capable of great improvement, by draining, and other means; but as the inhabitants depend so much upon peat, such improvements might occasion greater harm than good to a numerous class of the people, and therefore is not likely to be soon accomplished.

The mountains, especially those in the north part of the county, contain lead and other minerals in great abundance: but these are not now an object of attention, either because there is not a sufficient spirit of enterprise, or because the expence and difficulty of working them would more than counterbalance the probable profits. Formerly, however, they were in great repute, and found to be extremely productive. In Queen Elizabeth's time, a company of Germans made a great deal by the mines of lead and silver, the ore of which often gave seventy or eighty ounces of silver in the ton of metal. In the reign of James the First, Sir Hugh Middleton, for some years, out of a single mine, cleared at the rate of 2000*l.* per month, one ton of lead yielding a hundred ounces of silver, and in this way accumulated that large fortune, which he afterwards employed in bringing the New River water into London. A Mr Bushel also, who succeeded him, made such immense sums, that, according to one author, he presented Charles I. during the civil wars, with a regiment of horse, clothed his whole army, and lent him, besides, 40,000*l.* The mines wrought by these gentlemen were so much exhausted, as to become ever after of inferior importance. But the mineral prosperity of the north of Cardiganshire did not decrease. In 1690, other mines of great value were discovered on the estate of Gogerthan, belonging to Sir Carbery Price. They were so rich as to obtain the appellation of the Welsh Potosi, and have been celebrated, both in the prose records of the principality, and in the poetical strains of Yalden and Sargent. Afterwards the mine adventurers were at considerable expence in carrying on the works, and had proportionate success in the profits which they derived from them; but happening to disagree among themselves, their undertakings declined in prosperity and in value, and have never since been revived with advantage; though a gentleman well versed in the subject has given it as his opinion, that with money sufficient for carrying on the works in a proper manner, it was quite possible to make them produce a clear annual profit of 12,000*l.* The lead mines of Cwm Ystwith are situated on the sides of two mountains, to the right of the river Ystwith, in one of which the lead is obtained with ease near the surface, but in the other the earth must be penetrated to no less an extent than 300 yards. In Cardiganshire there are also rich veins of copper, which may be digged without great difficulty, but which cannot be carried with advantage through the different processes, for want of coal, of which there is not one particle to be found in the whole county.

The antiquities to be met with in Cardiganshire, are neither very numerous nor important. Near Neuodh, in the neighbourhood of Cardigan, there are the remains apparently of some barbarous monument, consisting of nineteen stones. There is another monumental stone in the parish of Llan Gaedmor, which is of prodigious size, being half a yard thick, and about six-and-twenty feet in circumference. Not far from this, is what the Welsh call *Llech y gowres*, which means the stone of a gigantic woman. This stone is remarkably large, and supported by four great pillars, about the height of five or six feet. In the village church of Lhan Dhewi Brevi, is preserved the horn of an ox, no less than 17 inches in circumference at the root, and as heavy as stone, being, it is probable, in a state of petrefaction. It is said to have been kept there ever since the time of St David, who lived in the beginning of the 6th century. At a house in the vicinity, is a place called *Kaer Kestilh*, or the Field of Castles, where a great number of stones, have been occasionally found by digging, bearing inscriptions, some of which have been preserved, though most of them are lost. One of them, according to Camden's interpretation, is, *Caii Artii manibus (vel memoriæ) Ennius Primus*. *Stratflour*, or *Ystrad Flwr* abbey, is situated about six miles from Llanbeder, on the bank of the river, and was in former times a place of great note, many of the Welsh princes having been buried in it, and the records of their acts and successions having been kept in it for a long series of years. At Llanfihangel, a parish not many miles from Aberystwith, is a stone monument, 4 feet long and 3 broad, which should seem, from its name, *Gwely Taleisin*, to point out the grave of Taleisin ben Bierdh, a celebrated poet, who flourished about the year 540. Some, however, suppose that, along with many others of a similar kind, it is an old sepulchral monument, erected in heathen times. Among the antiquities of Cardiganshire, may also be reckoned the castles of Cardigan and Aberystwith, which were anciently large edifices, though the ruins of them which remain are inconsiderable.

There is no district in South Wales, which abounds so much in picturesque and romantic views. Before the traveller can reach them, indeed, it is often necessary to pass over some very bleak and dreary ground. But he is amply repaid for this, by the interesting scenery which he is sure to meet with. It is on a pretty large scale, and in very fine style, exhibiting the grand and the beautiful, both singly and in combination. A very particular and excellent description of its more striking parts, is to be found in the work of Mr Malkin, referred to at the end of this article.

Though the people understand English better than they appear to do, the language of Cardiganshire is almost wholly Welsh. As the judges are English, the intervention of an interpreter becomes necessary: this circumstance occasions great inconvenience, and some very absurd and unfair decisions. The inhabitants, however, do not suffer much from this cause in a religious point of view; because the church services are almost universally performed in Welsh, so that none but the genteel part of the congregation are prevented from deriving benefit. The dialect which is spoken in this county, comes nearer than that in any other to the modern literary or written dialect.

The inhabitants of this part of Wales are peculiarly simple in their manners; they get but small wages for their labour; their mode of living is extremely coarse; their mud-walled cottages, (for they have no good stone for building, and no lime,) are ugly without, and squalid within; their internal intercourse, and their communication with other places, are very rare; they are seldom known to emigrate from the narrow spot of their nativity; and, like most other people in their circumstances, they are much given to hospitality.

The Bay of Cardigan, which bounds the west side of this county, abounds in various kinds of fish. There are cod, whitings, herrings, &c. In catching these, a great number of people find employment in the proper seasons. The monk-fish, otherwise called the angel-fish, is also found here in plenty, and sometimes so large as to weigh 160 pounds. It is said that blue sharks, of a monstrous size, have been sometimes seen; but from the description given of the fish, this is probably a mistake. In the river Tivy, very fine salmon are caught; and in the various streams which water this county, all the common fresh water fish are to be met with.

The only manufactures of any consequence in this county, are the iron and tin works, which where established in the neighbourhood of Cardigan, about 50 years ago, and which are still carried on to a considerable extent. From the want of good harbours, the maritime trade of Cardiganshire is comparatively trifling. The chief exports are iron, tin, black cattle, pigs, salt butter, barley, and oats. At the large fairs, of which there are several, a good deal of business is transacted in the staple commodities of the county. Rhosvair, in particular, a place near the source of the Tivy, is celebrated for its fairs of sheep and black cattle. A great proportion of the wool is spun and manufactured by the inhabitants for their own use. The rest, more especially the coarser part of it, is mostly sent to the English market.

Cardiganshire is, at an average, about 40 miles in length, and 20 in breadth. It contains 726 square miles, or 464,640 acres, of which about 145,000 are in pasturage, about 100,000 in a course of tillage, and the rest in waste, plantations, &c. It is divided into five hundreds, viz. Geneurglyn, Ilar, Moyddyn, Pennarth, and Troedyroyr; has five market-towns, viz. Aberystwith, Cardigan, Llanbadarnvawr, Llanbeder, and Tregaron; contains 77 parishes, and sends one member to parliament. It lies in the province of Canterbury, and diocese of St David's, and is included in the North Wales circuit. In 1801, the number of houses in it was 9040, and of inhabitants 42,956; of these, 20,408 were males, and 22,548 females; 2896 were employed in trade and manufactures, and 16,511 in agricultural pursuits. In 1811, the population was 50,260. In 1806, it paid 175,213*l.* of property-tax; and, in 1803, it paid one part of the land-tax, and 10,167*l.* of poor's-rate. See the *Description of England and Wales*, vol. i. p. 282; *A Tour in Wales, &c. in the Summer of* 1805, in Phillips' *Collection*, vol. iv.; *Agricultural Survey of Cardiganshire*; and Malkin's *Scenery, Antiquities, &c. of South Wales*, vol. ii. (τ)

CARDINAL is more particularly applied to an ecclesiastic in the church of Rome, who is a member of the conclave, and who is invested with the power of electing the pope.

The origin of this order is involved in a considerable degree of obscurity; but there can be no doubt that it derived its existence from the oligarchical nature of the form of church government adopted by the see of Rome, and the desire which all who have sat in the chair of St Peter have shewn to render the city of Rome the centre of all ecclesiastical power, and to which those who looked forward to the acquisition of dignities or preferment in the Catholic church, were alone to direct their attention. The aggrandisement of papal jurisdiction was a favourite object of pursuit with all the bishops of Rome; and by means skilfully contrived, and as skilfully executed, they succeeded most effectually in accomplishing their purpose.

Some difference of opinion has existed respecting the origin of the name *cardinal*; and yet it is strange that, upon a subject which appears to be so plain, ingenious men should call forth all their learning and acuteness in tracing the etymology of a word which appears to be so obvious, and accords so well with the analogy of the language. Among the Latins, the word *cardinalis* signifies principal. Thus, *quatuor venti cardinales*, the four cardinal or chief winds; *princeps cardinalis*, a sovereign prince; *missa cardinalis*, the great mass; and, *altare cardinale*, the great altar of a church. The name was even applied to those who held the chief civil offices in the state under the Emperor Theodosius.

The cardinals, who with the pope constitute the conclave, or sacred college, are composed of three distinct orders, viz. deacons, presbyters, and bishops. It may be proper to observe, that in towns there were three sorts of churches. The one was called *Tituli*, or parish churches, in which the people assembled for the general purposes of public worship, to hear the liturgies read, and to receive the sacrament. The second was called *Diaconiæ*, or deaconries, which were public hospitals for the benefit of the poor, and to these were annexed chapels. The third were oratories, in which it was not permitted either to administer baptism or the sacrament. Private mass was performed in them by chaplains or presbyters appointed for the express purpose, who had the title of local or stationary; and in order to distinguish the parish priests from those who officiated in the oratories, they assumed the name of *cardinales*, or cardinal titles, because their functions implied the privilege of administering the sacraments, from which the priests of the oratories were precluded. Though this appellation was exceedingly general, yet in a short time it was confined to those at Rome who assisted the Pope at the celebration of the mass, or attended him when any public procession took place.

The number of cardinals has been exceedingly fluctuating. Like all institutions that have existed for a long series of years, their number was originally inconsiderable. The deacon cardinals at first only amounted to seven, and were gradually augmented to fourteen and eighteen. They were afterwards reduced to fourteen. The priest cardinals are to the number of fifty, which, with the six cardinal bishops of Ostia, Porto, Sabina, Palestrina, Frascati, and Albano, make generally the number of seventy. It was a favourite object with the church of Rome to render the whole of its rites and ceremonies, and even the different orders or ranks which composed the whole, as sacred as possible. As they could derive little sanction from any precedent in the New Testament, they therefore had recourse to the Old; and, by a singular conceit, a resemblance was supposed to exist between the pope and Moses, and the cardinals and the seventy elders of the people. Till the year 1125, their number was only fifty-two or fifty-three.

The council of Constance reduced them to twenty-four. But as the see of Rome could never brook controul, Sixtus IV., totally disregarding the enactment of the council, restored the former number of cardinals, and Leo raised them to sixty-five.

When the pope purposes to create any cardinals, he causes their names to be read in the consistory, after he has informed those who are present, *fratres habetis*, that is, you have for brothers, &c. If those who are elected are not at a great distance, they are immediately sent for, and they receive red caps from his holiness. The cap is sent to those who are absent by a person of distinction, but they must receive the hat from his own hands; and when they are introduced for this purpose, they are received with great pomp and ceremony. Their dress, like that of all the different orders in the Romish communion, is prescribed, and defined with great accuracy. It consists of a *rochet*, over which is a short purple mantle; and, upon extraordinary occasions, the mozette, and a papal cap over it. The colour of their garment is either red or violet, according to circumstances. The regular cardinals wear no silk, nor any other colour, excepting that of their order. The red hat and cap are common to them all.

Whatever may have been the original occasion of the institution of this singular order, or by what means soever they acquired that ascendency over all the ecclesiastics of the same communion, it must appear evident, that in arranging the various ecclesiastical and political measures which were deemed most expedient to be adopted, the pope himself was altogether inadequate. His claim to supremacy, as well as that of the city of Rome to be considered as the metropolitan city of the Christian world, naturally gave a precedence, or rather a most substantial influence to those of the hierarchy who were near to the pope's person, and whose interest so powerfully co-operated with that of his holiness. In the course of time it became an object of the highest ambition to enterprising men to obtain a cardinal's hat. This was sometimes the reward of literary merit, or of having rendered essential services to the papal see; but, in general, the chapter consisted of opulent ecclesiastics, who, in consequence of their own private fortune, and the affluence and high rank of their family, or the political influence which they possessed at the different courts of Europe, rendered them persons upon whom it was expedient to confer honours. The cardinals can be viewed in no other light than that of the pope's privy council. All measures of state, or whatever regarded the real or supposed interests of the Catholic church, were first the subjects of consideration in the conclave, and the sanction of their authority was necessary to the validity of any measure which related to the interests of the church. Besides the influence that they necessarily possessed as the advisers, and even the leaders, of papal politics in the city of Rome, they were frequently employed in negotiations in foreign countries; and as a proof of the immense power that was vested in the Pope, they were designated legates *a latere*. They were thus inferior to the Pope, but in rank superior to any one else. Whatever may have been the manner in which the patriarch of Rome was at first elected, it is certain, that for many ages the cardinals have claimed this privilege as their unalienable right. They have even gone farther, and succeeded in establishing it as a settled point in ecclesiastical policy, that the head of the Romish church must be elected from their body. So eagerly did the Pope enter into this right, that Stephen ordered the body of his predecessor to be dug up, because he had only attained to the rank of Bishop when he was elevated to the papal chair. It was Urban VIII. who expressly commanded, that the cardinals should be addressed by the title of *eminence*. This decree was promulgated in 1630; previous to that period they were called *most illustrious*. They have long been esteemed as possessing a rank next to the pope. See *Du Cange*, *Onuphrius*, *Duarenus*, *Moreri*, *Ciaconus*, and *Mosheim*. (R)

CARDINAL Notes, in music, are, according to Ambrose Warren, those with long finger-keys on the organ, otherwise prime notes, viz. A, B, C, D, E, F, and G. The remaining five notes he calls adjuncts, or supplemental notes. (g)

CARDIOSPERMUM, a genus of plants of the class Octandria, and order Trigynia. See Botany, p. 198.

CARDOPATUM. See Brotera.

CARDS, Playing. As neither the manufacture of cards, nor the history of card playing, are subjects of any interest or importance, we shall merely refer our readers to those sources from which they may obtain information on these points.

In the 8th volume of the *Archæologia*, Daines Barrington, Mr Bowler, and Mr Gough, have written essays on the antiquity of card playing.

An account of the art of making cards by M. Duhamel, and approved of by the Academy of Sciences, will be found in the *Mem. Acad. Par.* 1762. p. 189. The existing laws respecting cards will be found in the Act 43 Geo. III.

CARDUUS, a genus of plants of the class Syngenesia and order Polygamia Æqualis. See Botany, p. 287.

CAREX, a genus of plants of the class Monœcia, and order Triandria. See Botany, p. 314.

CARGILLIA, a genus of plants of the class Polygamia, and order Diœcia. See Botany, p. 342; and Brown's *Prodromus Plant. Nov. Holl.* &c. p. 226.

CARIA was an ancient kingdom in Asia Minor; the limits of which are defined so differently by different authors, that we should be tempted to reject their authority altogether, were it not more congenial to the spirit of legitimate criticism to reconcile their discrepancy, by supposing that they describe this region as it was extended or contracted at different periods. We, perhaps, approximate as near as possible to the truth, when we say, that it was bounded on the east by Phrygia and Lycia; on the south by the Mediterranean Sea; on the west by the Ægean sea; and on the north by Ionia and the river Meander, which separated it from Lydea. Surrounded by the sea on two sides, its inhabitants were drawn to maritime affairs more than to agriculture; and hence its valleys, though numerous and well sheltered, were not so fruitful as the hand of industry might have rendered them; but its mountains were covered with flocks, the wool of which, from its superior quality, formed an article of commerce with the neighbouring states. The principal cities of this district, on the south, were Calinda, Caminus, Physicus; on the west, Cnidus, Ceramus, Halicarnassus, Myndus, Miletus; and in the interior, Antiochia, Laodicea, Trapazopolis, Aphrodisias, Apollonia, Alabanda, Stratonice, Tendeba, Pedesa, and Alinda.

Nothing is more difficult than to trace the name and the inhabitants of an ancient dynasty to their source, and in the present case we are involved in the deepest obscurity. Whether the Carians, as they assert, were aborigines, or, according to the assertion of others, Pelasgians or Cretans, is unknown; but the country rises on the page of history at a very early period under the name of Phœnicia,—a name originating in the dominion which the Phœnicians exercised over it. Car, who has descended to us as the brother of Lydus and Mysus, two princes who gave names to Lydia and Mysia, accompanied by a band of his countrymen, emigrated from Maeonia, the ancient name of Lydia, over which his father reigned; and settling in this region, called it Caria, a name derived from his own. This account, given us by Herodotus, receives some confirmation from a temple built at Mylases, dedicated to Jupiter the Carian, and in which, from the most remote antiquity, the Carians, the Lydians, and the Mysians, assembled together, as if descended from the same source, to worship their common god. Governed by the wisdom and defended by the bravery of Car and his descendants, the inhabitants of this country rose to power and to eminence, wrested the island of Rhodes from the Phœnicians; and, emboldened by this first success, embarked their daring veterans, and subjugated the other islands of the neighbouring seas. To reconcile the contradictory accounts which Thucydides and Herodotus give of their history after this period, we must suppose, with the former, that Minos II. forced them, at first, to abandon these islands; and, with the latter, that he afterwards allowed them to return to their possessions, upon receiving from them a number of ships to increase his navy. But when Greece advanced in power and enterprise, she landed various bands of bold adventurers on the coasts of Caria, and drove the inhabitants to the mountains and barren parts of the country. The hardships and dangers, however, to which the natives were thus accustomed, gradually formed them for the most daring exploits; and incited them, not only to recover the territory which they had lost, but likewise to push their conquests and their commerce by sea. It was about this period, that, having acquired by their skill and courage high military renown, they began as mercenaries to assist the neighbouring nations that were engaged in war, and their assistance was ardently sought and liberally rewarded. When, therefore, eleven of the twelve kings, who had divided Egypt among themselves, joined to expel Psammetichus from his division, that wise and magnanimous prince engaged the Carians with some other mercenaries to espouse his cause; and it was chiefly by their means that on the field he extinguished the hopes of his rivals, and united under his authority the kingdom of Egypt. About this period the independence of the Carians was threatened by Alyattes king of Lydia, who invaded their territories with a mighty army; but their address or bravery either averted or braved his superior power during his whole reign. The happier destiny of Crœsus, however, accomplished what his father attempted; and, in his victorious career, he rendered Caria dependent upon his throne, though it appears still to have been governed by its own kings.

The friendship which the Carians had formed with the Egyptians in the days of Psammetichus continued during the three successive reigns; and when Apries, the last of his race who wielded the sceptre, endeavoured to subdue his subjects, who, under the command of Amasis, opposed his tyranny, the Carians defended the authority and shared in the disgrace of that monarch on the plains of Memphis. They afterwards entered into an alliance with the usurper, which was confirmed with Psammenitus his son; and the bravest of his forces fell on the field of battle when that monarch yielded to the superior fortune of Cambyses and his Persians. The remainder of their troops returned to their own country, which was now almost reduced to a province of Lydia; but the vengeance of the Persians still pursued them, till, in the wreck of the neighbouring kingdoms, they swelled the triumph of Cyrus. But though subject to Persia, they were still governed by native princes; and when Xerxes formed the inglorious design of extinguishing the liberty of Greece, Artemisia I. who then ruled in Caria, augmented his fleet by joining him with her own, which she commanded in person. When that monarch held a council of war to decide on the propriety of engaging the enemy's fleet at the Streights of Salamis, this princess was the only person who had the wisdom and the courage to oppose the king, who was bent on the engagement: but when the attack was made, and the destruction of his fleet blasted the hopes of Xerxes, the same spirit which induced her to dissuade him from the dangerous enterprise, induced her also to maintain the combat with the most determined bravery. Her squadron was the last which retired from the conflict, and the reward of 10,000 drahmas which the Athenians offered to the person who should take her captive, as well as the declaration of Xerxes, that the men fled like women, and the women fought like men, consecrated her fame to future ages.

In this state of degradation, Caria groaned till about 444 years B. C., when Lydamis, either by the friendship or the permission of Persia, ascended the throne. The page of history has preserved little more than his name, and the names of several of his successors, from oblivion; and after a long and an inglorious interval, we find the sceptre in the hand of Mausolus. This prince, who changed the seat of government from Mylases to Halicarnassus, not only united and strengthened his native dominions, but took the advantage of the death of Artaxerxes to shake off the Persian yoke, and establish the independence of his country. He then gained signal advantages over the Ionians, Lydians, and Lycians, and assisted the inhabitants of Cos and Rhodes to break the fetters of Athenian slavery. But the glory of delivering them from a foreign yoke was for ever obscured, when, by corrupting their nobles he subjected them to his own; but at his death, they not only asserted their independence, but carried their arms into Caria. Artemisia II. the widow and sister of the late king, who had assumed the government, commanded the inhabitants of Halicarnassus to receive the Rhodians with the greatest demonstrations of friendship, in order to cut them off by stratagem; and when they were allured from their ships into the city, before ever they were aware, they were surrounded and slain. Artemisia having seized, by surprise, their fleet, set sail for Rhodes, entered the port amid the gratulations of the unsuspecting multitude, took possession of the capital, and slew all who had promoted the expedition into Caria. The Rhodians applied to the Athenians for assistance; and the Athenians, fired by the eloquence of Demosthenes, enabled them to expel their oppressors.

At the death of Artemisia, which happened soon after, her brother Idrieus ascended the throne, acknowledged his dependence on Persia, and, in obedience to Ochus, fitted out a powerful fleet, which, under the command of Phocean, made a descent upon the isle of Cyprus to subject it to the Persians, from whom it had revolted.

But, though the siege of Salamis was begun, nothing was performed to arrest our attention. At the death of Idrieus, Adda, his widow and sister, who had gained the affections of the Carians, seized the government, but was soon driven from her capital by Pexodorus, whom Darius had made viceroy over that kingdom. To Pexodorus, Orontabatus succeeded; and Adda was forced to shut herself up in the city of Alinda, which she fortified, and held in defiance of her enemies. But when Alexander marched to subvert the throne of Persia, he was welcomed and assisted by Adda; and when that prince had levelled with the ground the walls of Halicarnassus, which alone dared to check his victorious career, he established her authority over all Caria. Her reign was, however, short; and in her was extinguished the royal race, and the independence of her country. At the death of Alexander, Caria composed a small part of the territories that owned the authority of Cassander; it has since shared in the revolutions which have agitated Asia Minor, without the hope of vindicating its freedom; and there is no probability that it will ever again claim the honours of an independent state. (J. N.)

CARIBBEE ISLANDS, is the name given to a semicircular range of islands lying between Anguilla and Tobago, between the parallels of 11° and 19° of north latitude, and including both these islands. The principal islands, beginning from the north, are Anguilla, St Martin's, St Bartholomew, Barbuda, Saba, St Eustachia, St Christopher's, Antigua, Montserrat, Guadaloupe, Dominica, Martinique, St Lucia, Barbadoes, St Vincent, Grenada, and Tobago. A full account of these islands will be found in this work under their respective names. (*o*)

CARICA, a genus of plants of the class Diœcia, and order Decandria. See BOTANY, p. 331.

CARILLONS, or BARILONS, in music, is the name of small instruments furnished with bells, properly tuned, that are acted on by finger keys, like those of the pianoforte, and used for accompanying certain songs, where the ringing of church bells are to be imitated, and where dampers are not used, for preventing the continuance of the sound. In Holland and some parts of the Netherlands, the steeples of the churches are furnished with a large series of bells, tuned accurately to the tones and half-tones of the scale, and with strong wires that are connected at one end with hammers that strike the bells, and at the others with keys, and pedals for the lower notes of the scale, on which persons called Carilloneurs perform music in parts, by striking the keys rather forcibly with their hands and feet. (*g*)

CARINI, a town of Sicily, situated in the fertile valley of Muzora, and from some ruins supposed to be built on the site of the ancient Hyccara. The town, which is neatly built, is encircled by high rocks, and the adjacent country is highly cultivated, and produces grain of all kinds, olives, fruits, and manna. Swinburne makes the population 4000, and Denon 7000. See Swinburne's *Travels*, vol. iii. (*o*)

CARINTHIA, a duchy of Germany, in the circle of Austria; bounded towards the east by Styria, towards the north by the same duchy and the archbishopric of Salzburg, to the west by Tyrol, and to the south by the Venetian territories and by Carniola. It is situated between 46° 20′ and 47° 6′ N. Lat., and between 12° 32′ and 14° 50′ E. Long. Its greatest length, from east to west, is about 118 miles, and its greatest breadth about 50. The aspect of this country is in general woody and mountainous. The Noric Alps pass through this province, whose tops of granite, rounded into immense domes, are covered with perpetual snow and ice. St Ulrich, St Helena, St Veit, St Laurence, the mountains of Lobel, which separate Carinthia from Carniola, and those mountains which lie in the direction of Tyrol, are named as some of the loftiest mountains that occur in this quarter. So much of the whole extent of the duchy is occupied by such elevated grounds, that though the vallies which run between them are abundantly fertile, the produce, upon the whole, is not ordinarily equal to the consumption. In compensation, however, for this defect, the means of a lucrative commerce are found in the productions with which this province more abounds, and which are more of a nature to be expected in a country so situated and distinguished by such characteristic features.

Carinthia abounds in valuable mineral productions. Its mountains yield very good iron. The principal mines of this description are at Huttenberg, Mosnir, Loelling, Waldenstein, Sainte Gertrude, and St Leonard. It has also copper mines at Fragant and at Lambertiberg. Carinthia has been much noted for its lead, of which the principal mines are at Villach, at Siharzenbac, and at Ræbel. It has silver mines at Steinfeld and at Meiselding, and one of gold at Groskischheim. Of its iron mines, those near Friesach, on the north, and in the tract among the springs of the Lyser, are particularly famous. The iron of Friesach is perfectly equal in quality to that of Styria, which has gained such high reputation, and which we know to have been very long in possession of it, as we find it greatly extolled by Pliny and others of the ancients, and learn, that it was commonly used by the Romans in the manufacture of their swords. The lead of Carinthia is excellent, and it is an article of great consequence for this country. In that department, the mines of Villach are particularly remarkable, both for the abundance and the superior quality of their produce. The lead obtained here is commonly known in Europe by the name of the yellow lead of Villach. This substance occurs also in some of the contiguous districts, but is not equal in goodness. Lead mines have been wrought in Carinthia from a very remote era: that near Bleiberg has been wrought for 1100 years. The produce of this duchy, in the most considerable of its metals, has been thus stated: Of iron it is said to yield annually to the amount of 165,000 quintals, of copper 936 quintals, and of lead 37,000 quintals, valued at 330,000 florins. The other mineral productions of most consequence in Carinthia, are Calamine, bismuth, beautiful blue granite, marble and alabaster, nitre, and bolar earth. Of calamine there are found here several sorts, in all to the amount of 3400 quintals annually. In some places there occur likewise alum, vitriol, cobalt, sulphur, and other minerals of inferior importance.

The principal vegetable produce of Carinthia consists in its woods, pastures, and a few cultivated crops. Turpentine, the produce of the pine tribe, is procured from this quarter in abundance, as also birch juice. The vallies and lower parts of the hills furnish excellent pasture, which is further improved in the spots that admit of such melioration, by the culture of lucerne and of clover. The crops which in all countries in this quarter of the globe chiefly contribute to the subsistence of mankind, viz. wheat, rye, oats, and barley, are in greater or less quantity raised here, as well as generally in every district of the empire. The produce of wine is scanty,* and the wine itself is of an inferior quality; but a wholesome beverage is found in the beers, or ales of two sorts, which are commonly brewed in the country. A great deal of cider is made here, which implies an abundance of the fruit from which that liquor is prepared. Besides apples, various other sorts of fruit trees are cultivated in this province, and to a considerable extent. A little flax is raised also, chiefly in the environs of Saxenburg; and, among the numerous medicinal and aromatic plants that cover the sides of the Noric Alps, there is one that is called in German Speik, (*Spica Celtica*,) which is much esteemed by the Turks and other Eastern people as a perfume; and which, therefore, being collected and dried, forms a considerable article of commerce with the Levant.

The pasture grounds of Carinthia maintain great herds of cattle. The numbers of horned animals of different descriptions found in it in 1780, have been estimated at 47,836. The north-western parts of the duchy have been chiefly noted for this sort of stock. The common breed generally throughout the province is good and strong, though not of the largest size. Dairies are usual here of a similar description with those of Switzerland. The number of horses in the country, at the period alluded to, was stated at 21,490. Sheep are not numerous, nor does the pasture in this quarter seem, in general, to be well adapted to the maintenance of that species of stock. Swine are raised in considerable numbers in the eastern parts of Carinthia; and in the forests there are found wild goats, as also bears, red, brown, and white.

The climate of Carinthia is such, as does not prevent the vines and corn of Turkey, though natives of a region so much more southerly, from arriving at perfect maturity. The air is somewhat cold, but it is pure, tolerably equal, and wholesome. The prevailing winds are the west and the north-west. The range of the thermometer in the vallies and low-lying grounds is from 35° to 40°. This extent of variation is not considered to be so dangerous to health as the occasional stagnations of the air amongst the hills. The winter season lasts here for the space of three, sometimes four months. The spring is mild and kindly, rarely very wet. The summer is pretty warm, but attended with much stormy weather. The most agreeable season is the autumn, reckoning from its commencement till the end of the vintage. The harvest is usually begun, perhaps even far advanced, by the middle of July.

The duchy of Carinthia abounds in lakes, brooks, and rivers. The largest of its lakes, known by the name of Wordtsee, is eight miles long. Its principal river is the Drave, which issuing out of the Tyrol, traverses the whole of this province in a direction from west to east. Besides it, there are the Gail, the Moll, the Lyser, the Glan, the Gurk, and the Levant. Both the rivers and the lakes generally abound with fish.

Carinthia is divided into the Lower and the Upper Carinthias. In the former division, the principal towns are Klagenfurth, St Veit, Friesach, Volken, St Andrée, Wolfsberg, and Gurk. Those of Upper Carinthia are Villach and Gmund. The states are constituted here as in Austria, their assemblies being held at Klagenfurth, which is considered as the capital of the whole province. This is the seat also of the ordinary administration for one part of the duchy; that for the other is at Villach. The military establishment of Carinthia is under a governor or land-captain. A regiment of foot is usually quartered here; and to the military state of the house of Austria it has been accustomed to contribute annually to the amount of 637,695 florins.

Christianity was introduced into this duchy in the 7th century. The system of religious belief, and practice generally acknowledged over the whole of it, is that of the Roman Catholic Church, which properly, indeed, is the only one that is tolerated, though there are also found in the country many Protestants and adherents to the Lutheran doctrines. There are here two bishoprics, nine chapters, and nineteen convents. The bishops are those of Gurk and Lavant, who are subject to the archbishop of Salzburg; in which dignitary, as well as in the bishop of Bamberg, there is also vested a considerable portion of the territory of this country.

In regard to the spirit of industry, and of manufacturing and commercial enterprize, the people of Carinthia, compared with the inhabitants of the other provinces of the empire, hold a sort of middle state, having their minds less directed towards such objects than the inhabitants of Bohemia, Moravia, and Austrian Silesia; but in a proportional degree more so than those of Hungary, the two Gallicias, Transylvania, and Istria. As to the matters which in this department have principally excited their attention, this, of course, fell to be regulated in a great measure by the nature of their produce. The mines are the great source of the riches of Carinthia; and its principal manufactures, accordingly, are those of steel and iron. In 1789, Carinthia is reckoned to have had 149 wire-drawing mills, 82 forges for nails, and 267 ordinary forges. Here the renowned steel denominated Brescia is made. The manufacture of arms at Fertlach occupies 500 persons. There is also at Friesach, in this district, a great manufactory of silver lace. From the lead that is furnished here in such quantity and perfection, a great deal of ceruse is prepared. Goats' and chamois skins are also a considerable object of attention, and the workmen in those branches are in high reputation. One of the principal branches of the commerce of Carinthia, is that which consists in the transport of those vast numbers of cattle that are sent from that country into the states of Venice. It exports, at the same time, various other articles, either in the form of raw produce, or of manufactured goods. These are chiefly its iron, steel, lead, copper, calamine, flax, linen, hides of animals, horses, grain, and cloths. Its imports are wines, spirituous liquors, sugar, cotton, coffee, drugs, corn, cloths, and salt. This country is stated to sell, in common years, to the amount of 1,470,373 florins, and it buys to the amount of 895,172 florins; thus obtaining a balance in its favour to the amount of 575,201 florins. In a more general view, the whole extent of the income of the duchy has been considered to amount to 2,550,897 florins; its annual expenditure to 2,342,564 florins; thus leaving to it disposable funds to the amount of 208,333 florins. Of the whole aggregate of the returns which this duchy obtains annually from articles exported, more than a half is commonly derived from the produce of its mines. The trade of the duchy, in general, is maintained and regulated by its chamber of commerce.

The amount of the sums which the province of Carinthia has contributed to the general funds of the state, has for several distinct years been reckoned to stand thus: Busching estimates the contribution for 1770, at 2,386,884 florins. Schlæzer states its contribution for the year 1780, to have been 1,250,000 florins. In 1803, according to the manual of Francfort, Carinthia contributed to the general funds of the state 2,500,000 florins; or, according to Ockhart, 2,600,000. The annual return from this province to the Montanisticum, or that particular revenue which the emperor derives from all the mines in his dominions, is 48,351 florins.

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* The quantity of wine produced annually in Carinthia is estimated at 100,000 eimers The eimer is a measure of 2852 cubic inches.

With respect to the situation of its towns, the appearance of its buildings, or other circumstances chiefly of a local nature, Carinthia offers little to attract particular attention. Klagenfurth, though it cannot be called handsome, is yet a large and pleasing town, and contains several considerable edifices, as well as spacious squares. This is the residence of the princes of Porzia and Rosenberg, and a great number of counts and inferior nobility. The streets are spacious, intersecting each other at right angles; and the public monuments, statues, and fountains, which are generally of large dimensions, though they convey no very favourable idea of the state of the arts in the country, yet serve to give to the place an appearance of dignity and importance. The city is surrounded by walls and a ditch, but these are not in any respect of such a nature as to constitute it a place of strength. St Veit is a pretty town, with handsome houses, and a spacious market-place. There is here a fine fountain, the water of which falls into a basin of good form, hewn out of a single block of white marble, and which, according to Busching, is five fathoms in circumference. This is said to be a Roman antiquity. About half-way between these towns is a swampy tract, called the Saalermoss, which has been considered by some to be the site of the ancient Tiburnia. Busching says, that on this plain there are still to be seen the ruins of an ancient town; but Kuttner, when travelling in that quarter, could not, it seems, discover the traces of any such ruins, nor even learn by tradition any thing of their existence.

Wens are a prevalent disorder in Carinthia, as well as in the adjoining province of Styria. When these have attained a certain size, they may generally be considered as indicative of a state of idiotcy. Hence it is, that cretins, or idiots, are not uncommon in those parts. There are different gradations of them, but seldom any occur in such a state of mere vegetancy as those that are met with in the Valais in Switzerland. Various causes have been assigned for this melancholy phenomenon. Two of these may be mentioned. They have been attributed by some writers to confined air, others have considered them to be the consequence of the badness or the scarcity of water.

The history of Carinthia comprises few topics of great interest. This province was formerly a part of Carnia and Noricum, and it derives its name from the ancient inhabitants of those regions, the Carni, to wit, who were a colony of the Celtes, and were called in later times Carantini and Carinthi. The present population of the country is descended partly from the ancient Germans, and partly from the Wends. This duchy at one time formed a part of Bavaria. In 1282, the Emperor Rodolph I. conferred it as a fief on the Count of Tyrol. He having entered into a compromise with Albrecht of Austria, in respect of which it was, on the extinction of his male issue, to descend to the heirs of Albrecht; it was, accordingly, in 1335, put in possession of the Austrian Duke Otto. At the time of the division of the Austrian states, in 1395, this duchy, with some others, devolved upon the Styrian line, and was held by the Styrian branch of that line. Under Maximilian I. it formed one part of the monarchy. It has since continued to belong to the Austrian family, and of course is at present vested in the emperor as head of that house. This duchy was in 1797 over-run by the French, under Bonaparte.

The following interesting particulars are extracted from the latest statistical account of the Austrian monarchy.

The population, in 1801, of the circle of Klagenfurth, 176,762; of Villach, 117,815; and of the whole duchy, 300,000. Number of marriages, 2912; of births, 8260; and of deaths, 7288.

Cities	11
Market-towns	5
Villages	2,801
Houses	51,313

Ecclesiastics	606
Nobles	505
People in employs	606
Citizens	4,998
Peasants	27,932
Artisans	21,399
Lodgers	44,502
Males	139,028
Females	146,505
Families	48,266
Protestant parishes, 1789	16
Protestants	15,355
Convents after the reduction	19
Germans	250,000
Slaves	50,000

See Peuchet's *Dictionnaire Universel de la Geographie Commerçante*; *Tableau Statistique de la Monarchie Autrichienne*, par Raymond & Roth; *Ann. des Voyages de la Geogr. et de l'Hist. publiées* par M. Malte Brun; and Kuttner's *Travels*. (K)

CARISSA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 137.

CARLINA, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See BOTANY, p. 286.

CARLISLE, a city of great antiquity, in the north of England, and the capital of the county of Cumberland, is delightfully situated in a fertile vale, on the south side of the river Eden, which falls into the Solway Frith, five miles below; having the Pettrell on the east, and Caldew on the west, both of which empty themselves into this river, the former about a mile above the city, and the latter about half a mile below it. It was till very lately surrounded by ancient walls, most part of which have been removed, in order to afford materials for the construction of the new court-houses, and to enlarge the town. Various opinions have been entertained by antiquarians respecting the etymology of the word Carlisle. It was called by the Romans and Britons, *Luguvallium*, and *Luguballium*, or *Luguballia*. The most probable notion is, that it is derived from the Celtic, *Caer*, a city; and *Lucl*, signifying the town or city of Luel.

The history of Carlisle, prior to the time of the Romans, is involved in much obscurity; nor have we any well authenticated account of the size or form of the place in distant antiquity. Leland, an author whose accuracy and veracity can hardly be disputed, observes, "The hole site of the towne is sore chaungid. For whereas the stretes were, and great edifices, now be vacant and garden plottes. The cite of Cairluel stondeth in the forest of Ynglewood. The cite ys yn compace scant a myle, and ys walled with a right fayre and stronge wal, *ex lapide quadrato subrufo*. In diggyng to make new buildyngs yn the towne, often tymes hath bene, and now alate fownd diverse foundations of the old cite, as paivmentes of stretes, so hold and mauldid, that when yt was strongly touched yt went almost to mowlder." After the departure of the Romans, it declined till the 7th century, when Egfrid, king of Northumberland, rebuilt it, and encompassed it with a strong wall of stone. From the time of this prince to the arrival of the Danish invaders, it is supposed to have been much augmented in importance and power. When, however, those barbarous ravagers had possessed themselves of the northern part of this island, it appears to have undergone a destruction so complete, that it continued a heap of ruins till the time of the Norman conquest, when one of William's subjects is said to have built some parts of the city. But it was not till the reign of King William Rufus, that the ecclesiastical buildings were erected, and the city fortified. Henry I. erected Carlisle into a bishop's see, and appointed Adelulph, his confessor, the first bishop; and likewise completed the monastery. Stephen, about the beginning of his reign, gave this country to David, king of Scotland, to procure his aid against Henry II. After the death of David, which happened not long after, Stephen took Carlisle from the Scots, and granted to the city the first charter, which was afterwards consumed by an accidental fire. In the 29th of Henry VIII. Carlisle was besieged by an army of 8000 men, and being repulsed by the garrison, were afterwards intercepted by the Duke of Norfolk, who ordered the leaders with 70 others to be immediately executed on the city walls. In 1644 this city was surrendered to the parliament forces under General Leslie, after a siege of nearly eight months. In 1745, Carlisle was taken possession of by the rebel army, commanded by Charles Edward Stuart, and afterwards retaken by the king's forces, under the Duke of Cumberland. During these unhappy times, Carlisle was a place of considerable military importance, and kept up the appearance of a formidable place; sentinels were stationed at every gate, on the walls, at the castle, &c. and the gates were shut and locked every night with much military parade; and, as a signal when to shut the garrison gates, a gun was fired in twilight, when a white horse could not be seen at the distance of a mile from the fortifications.

So late as the beginning of the last century, the dwellings of the inhabitants were mere hovels, constructed principally of wood, laths, and mud; the gabels fronted the streets, the doors were generally in the centre, and many of the houses had porches projecting two or three yards into the streets. The front door was arched or Gothic, to correspond with the gabel, and the diminutive windows were of the same order. The doors were of oak, remarkably strong and clumsy, put together with wooden pins, a part of which projected a considerable way from the door, and sometimes placed in figures romantically irregular. The streets were badly paved, and had ditches or kennels on each side, which being the reservoirs of all kinds of filth, rendered the air impure, and consequently the city very unwholesome. But as the prospect of future warfare vanished, trade and manufactures began to increase, and an equal augmentation of wealth, spirit, and taste for improvement, took place; so that Carlisle, at the present day, in the openness of its streets, neatness and elegance of its buildings; and respectability of its inhabitants, is excelled by few towns of equal size in Great Britain. Carlisle affords several commodious inns, and maintains an intercourse with other parts of the island by several regular mail and stage coaches, waggons, &c. There is a stone bridge over the Caldew on the west side, leading into the city, and two on the north side over the river Eden, one of four and the other of eight arches; all of which are extremely narrow and ill constructed. Parliament have very recently granted the sum of 10,000*l.* to the county, for the purpose of building a new bridge over the Eden; and we understand that the magistrates have ordered it to be immediately begun.

From the market-place, the principal streets, called English-street, Castle-street, Scotch-street, and Fisher-street, diverge as from a centre. At the head of the latter, is the ancient Guild-hall, a mean edifice, built of brick, and appropriated to the meetings of the eight free trades, viz. merchants, butchers, tanners, weavers, tailors, skinners, smiths, and shoe-makers.

Carlisle contains a few public buildings deserving of particular notice. The Cathedral church of St Mary's, is a venerable structure, partly of Gothic and partly of Saxon architecture; where is performed the parochial and cathedral service, and in a part of it the chancellor of the diocese holds the consistory court. The choir and aisles of this building are of beautiful Gothic architecture, with clustered columns and pointed arches. In the aisles, on each side, are many singular legendary paintings, of the history of St Augustine, St Cuthbert, and the Romish St Anthony. In the Abbey, contiguous to the church, and in which the church properly stands, are several ancient buildings, the deanry, fratery, &c., which has been lately considerably improved by the dean and chapter. St Cuthberts, the other parish church, is a modern edifice, plain, and without ornament. Besides these two churches, there is, in Carlisle, a Quaker's meeting-house, a Presbyterian chapel, two Methodist chapels, an Anabaptist chapel, and a Catholic chapel.

The castle is situated on a gentle eminence, at the north west extremity of the city. The donjon, or great tower, whose walls are 12 feet in thickness, constructed agreeably to the old mode of defence, was formerly strengthened by a draw-bridge over a wide ditch; there is also a half-moon battery mounted with cannon, and a large platform also mounted under cover of the outer wall. A well of vast depth, within the tower, supplied the garrison with water. In the outer castle is a fine grass plot, a garden, a governor's house, and an armory lately erected, capable of containing 10,000 stand of arms. Here the dreary dungeon is shewn the curious visitor, where Mary queen of Scots, whose beauty, misconduct, and misfortunes, are alike famous in history, was confined, after her defeat at Langside. During her imprisonment, the royal captive used to walk in front of the castle, which yet retains the name of the Lady's

Walk; and tradition says, that with her hand she planted some ash trees, whose spreading branches till lately shaded this consecrated walk.

That the castle of Carlisle has been a Roman fortification, there can hardly exist a doubt; but having always, in times of commotion and tumult, been the assailable point, it has undergone so many alterations and repairs, that there is scarcely a fragment of the original building to be discovered. The old centre tower, or keep, appears, from the stile of the architecture, to have been constructed in the reign of Edward I.; and at some parts of the basement of the external buttresses of the north wall, where the modern casing of stone added to it in the reign of Henry VIII. is broken down by the decay of the embankment below, a part of the original may easily be observed. The stones of this wall being different from any in the other parts of the building, and corresponding exactly with the materials that compose the remains of the great Roman wall which crossed the northern counties of England, it is not unreasonable to suppose the castle nearly of the same date, and, consequently, erected by the Roman emperor Adrian. The base of this still extends to the bottom of the hill on which the castle stands, and has been erected as a bulwark to defend and secure the fabric against the floods of Eden, which river appears to have formerly run under the castle walls. The various alterations and additions that have been made to the castle at different periods, can easily be traced to the reign of Elizabeth, when it underwent a thorough repair; and from thence to the time of Oliver Cromwell, when the keep was converted into a battery, and long guns, in order more effectually to command the town, mounted on the roof.

In 1807, an act of parliament was obtained for erecting court houses, &c. on the site of the citadel adjoining the English gate. The work was immediately begun, on a very extensive plan, and is now nearly completed. The citadel was a very large building, consisting of a strong square tower, connected to two large bastions, and was built by order of Henry VIII.

The county goal is a mean edifice, built of stone, and situated at the head of English Street. No furniture belongs to the prison, but what is found by the unfortunate persons confined there, who are allowed merely straw for their beds. The city prison is placed above the Scotch gates.

The town hall, or Moot Hall, and council chamber, stands in the centre of the city, where is held the courts of assize, the quarter sessions, the mayor's court; and there two members of parliament are elected for the city. The council chamber is ornamented with a cupola and clock.

Carlisle contains few charitable institutions. A dispensary was first established in 1782, where the medical gentlemen are in the habit of giving their advice and attendance gratuitously. The apothecary, whose duty is to prepare and deliver the medicines prescribed by the physicians, has a salary of about 60*l. per annum.* There are two workhouses for the maintenance of the indigent poor, a school of industry, where thirty girls are taught sewing, writing, reading, &c. and two schools supported by subscription, one on Lancaster's and the other on Bell's plan, besides Sunday schools.

The corporation consists of a recorder, twelve aldermen, twenty-four common councilmen, and two bailiffs. One of the aldermen is annually elected mayor, and the other annual placemen are chosen out of the common council. The subordinate officers are three serjeants at mace, five beadles, or town scavengers. The serjeants act as bailiffs in processes before the mayor's court; and to them is committed the execution of summons and writs of arrest for debt issued for it. The serjeants and beadles wear the corporation livery, which is brown turned up with red; and their places are generally for life. The office of the latter is to keep the streets clean, and to put into execution the punishment awarded to offenders within the mayor's jurisdiction. The liberties of the corporation extend a few yards without the site of the city walls, and are ascertained by what is called the Freelidge-stone.

The printing or stamping of cotton was first established in the year 1761, which was followed by weaving, and afterwards spinning; all of which branches have been carried on to a very great extent. Carlisle was formerly celebrated for its manufacture of fish hooks and whips, though not much so at present. There are four public breweries, and three iron and brass founderies. It also possesses five flourishing banks, two of which issue notes on their own account. The importations to Sandfield, commonly called Port-Carlisle, consist principally of iron, tar, deals, slates, salt, sugar, rum, &c.; and the exportations consist of grain, oak bark, flour, timber, lead, alabaster, &c.

The air of Carlisle is particularly salubrious. The population of the city and suburbs, accurately taken at four different periods, was as follows:

In 1763 there were	1050 families, and	4158 inhabitants.
1780	1605	6299
1796	2314	8716

In the year 1802, the enumeration, according to act of parliament, was 1420 houses, and 10,875 inhabitants; of these 5133 were males, 5742 females. Owing chiefly to the establishment of cotton mills, and the spirit of trade, the population has of late years been rapidly increasing. —The following are the population returns for 1811:

Inhabited houses	1,658
Families which occupy them . . .	2,829
Houses building	7
Houses uninhabited	51
Families employed in agriculture . .	134
Ditto in trades, manufactures, &c. . .	2,301
Ditto in neither of these classes . . .	394
Number of males	5,628
Number of females	6,903
Total population	12,531

The market day, every Saturday, is abundantly supplied with provisions of all sorts, and is considered by the farmers as one of the best corn markets in England.

Immense strata of siliceous sandstone, usually denominated *freestone*, occur in the neighbourhood, from whence the stones employed in building are principally obtained. Gypsum, or alabaster, is also found here. Several Roman coins and antiquities have, at various times, been found in and about Carlisle. Distance from London 301 miles, from Edinburgh 96, from Dublin 200. For further information on the subject of this article, see Hutchinson's *History of Cumberland.* Burns and Nicholson's *History of Cumberland.* Camden's *Britannia.* Hook's *Archæologia.* Horsley's *Britannia Romana.* Leland's *Itinerary.* Pennant's *Tour from Downing to*

Alston Moor. Jollie's *Cumberland Guide and Directory*. (J. S.)

CARLISLE, New,* the principal town in the county of Cumberland in Pennsylvania, is pleasantly situated in a plain near the southern bank of Conedgwinet creek, a water of the Susquehannah. The houses, which are built of stone and brick, are tolerably good. The town is regularly built, the streets intersecting each other at right angles; and the principal public buildings are Dickinson's college, a court house and gaol, and four places for public worship, which belong to the Presbyterians, Germans, Episcopalians, and Roman Catholics. The college was founded by John Dickinson, Esq. the author of several tracts, and its revenue arises from 4000*l.* on funded certificates, and 10,000 acres of land. It supports a principal, three professors, and has a good philosophical apparatus, and a library containing more than 3000 volumes. Mr Ashe, in his travels recently published, remarks, that "Carlisle has a college, and the reputation of a place of learning. This may be so, but I have the misfortune to dispute it; and though indeed I saw an old brick building called the university, in which the scholars had not left a whole pane of glass, I did not meet a man of decent literature in the town." Number of houses 400. Population 1500. West Long. 77° 6′, North Lat. 17° 47′. See Morse's *American Gazetteer*, and Ashe's *Travels in America in* 1806, Letter 1. (*w*)

CARLOW, or Catherlogh, a county of Ireland, in the province of Leinster, bounded on the north by Kildare, on the north-west by Queen's County, on the north-east by Wicklow, on the south-east by Wexford, and on the west and south-west by Kilkenny. The part of the county which lies to the west of the river Barrow, is covered with high and rough hills, and in the south-eastern part that is contiguous to Wexford, there is another mountainous district, stretching from the rocky mount called Leinster to another eminence called Blackstairs. The level part of the county is rich and fertile, the soil is of a calcareous nature, and in many places the cultivation has extended considerably up the sides of the mountains. Leases which formerly ran for thirty-one years and three lives, have been of late granted for twenty-one years and one life; and the fee has been more transferred here than in any other part of the country. The average rents in this county are 50*s.* per acre. The following is a statement of the quantity of cultivated and uncultivated land.

Baronies.	Cultivated Land. Acres.	Mountains and Bogs. Acres.
Ruthvilly .	28,510	
Carlow .	18,487	
Forth . .	21,601	1,937
Idrone .	38,615	7,100
St Mullins .	16,303	3,171
	123,516	12,217

Carlow is reckoned one of the first dairy counties in Ireland. The dairies consist of from 20 to 50 cows, and, during the season, produce 1½ cwt. of butter per cow. Barley of the best quality is raised in Carlow, and a larger quantity is sown than in any other part of the kingdom. It is carried by the canal from Carlow to Dublin; and in the north it is consumed by the illicit distilleries.

Iron ore, a considerable quantity of oxide of manganese, limestone, marle, and a great variety of clays, are found in the county; but its mineralogy has not yet been carefully examined.

The principal river in Carlow is the river Barrow, which traverses the county from north to south, and forms its western boundary for many miles. This river is navigable, and its navigation has of late been greatly improved. The river Slaney also crosses the eastern part of the county, and, though small in size, it contributes to the beauty of the surrounding districts.

Carlow is about 33 English miles long from north to south, and 29 miles broad at its greatest breadth. It contains 220,098 English acres, or 344 square miles, and is divided into 50 parishes. The principal towns are Carlow, Leighlinbridge, Tallow, Palatine town, and Rutland, Hacketstown, Clonegal, and Gousbridge. The number of houses is 8763, which, at the rate of five to each house, gives a population of 43,815. See *Transactions of the Dublin Society*; Young's *Tour in Ireland*; Beaufort's *Memoir of a Map of Ireland*; and Wakefield's *Statistical and Political Account of Ireland* London, 1812. (*j*)

CARLOW, Catherlogh, or Catherloch, a word which signifies the *fortress in the lake*, is the capital of the county of Carlow, and is situated on the east side of the river Barrow, in the north-west part of the county. The town, which is regularly built, is superior in riches to most towns in Ireland, and has some good public buildings. There are here some ruins of a fine abbey, which was built in A. D. 634. The town was formerly walled, and defended by a castle, which has a turret situated upon an eminence which overhangs the Barrow. Considerable quantities of coal and coarse woollen cloth are exported; and its trade is facilitated by the improved navigation of the Barrow, which communicates with Waterford river, and with the grand canal. Coarse implements, such as reaping hooks, scythes, or sheers, are manufactured here. There is a large seminary in Carlow for the education of Roman Catholic priests. The part of the town called Grainge, on the Queen County's side of the bridge, contained, in 1806, 1240 inhabitants, and Carlow 5335, in all, 6575 inhabitants, and 1409 houses. West Long. 6° 58′, North Lat. 52° 50′. See Beaufort's *Book of Roads*; and Wakefield's *Statistical and Political Account of Ireland*, London, 1812. (*j*)

CARLSBAD, or Wary, a town of Bohemia, in the circle of Saatz, situated on the river Eger, and celebrated for its hot springs, which were discovered in 1370, by Charles IV. while he was hunting. This town, which is now much frequented as a watering place, contains several public buildings, such as the church, the Hotel de Ville, the new theatre, the hall of Bohemia, and that of Saxony. The part of the town called the *Wiese*, or the *Meadow*, is the most healthy and agreeable quarter of the town. It consists of a long range of houses, before which is an esplanade adorned with fine chesnut trees, and which stretch even to the banks of the river Toepel. The lower story of the houses is occupied by shops and work houses. Carlsbad is most frequented in the months of June and July. The principal manufactures of the place are, works of tin and Damascus steel; and the arms fabricated here are known over the whole of Europe. The principal spring, called the *Sprudel*, discharges, with great velocity, about 352 cubic feet of water hourly, through a curious natural vault, or incrustation of stalactite, and has a temperature of 165° of Fahrenheit. An esplanade and a fine salloon, built by M. de Saldern, the Russian minister, serves as a promenade to those who drink the waters. The *Neubrunnen*, or New Spring, is not so warm as the former. It has, however, been in great request for some years, and several changes have been proposed on the basin which receives it. Here is the *Muhlenbad* and the *Theresienbrunnen*, with a house built by the Empress Maria Theresa, the lower story of which contains very fine baths and apartments for the bathers. The *Schlossbrunnen*, or Spring of the Castle, has been more recently discovered. It contains more fixed air than the rest, and has a temperature from 120° to 125° of Fahrenheit. The *Kalte Sauesling* is another excellent spring, which issues out of a rock of granite behind the brasiery, but has no basin. It is covered with a stratum of fixed air, about five inches thick.

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* It is not called *New* Carlisle, but simply Carlisle.

According to the experiments of Klaproth, one hundred cubic inches of the Carlsbad water contains,

	Grains.
Dry carbonated soda	39
Equal to 107½ grains when crystallised.	
Dry sulphate of soda	70½
Equal to 168 grains when crystallised.	
Muriate of soda	34½
Carbonate of lime	12
Silex	2½
Oxide of iron	⅛
Of carbonic acid 32 cubic inches.	
	158⅝

The waters of Carlsbad are used in a great variety of disorders, but particularly in dyspeptic complaints, obstructions of the abdominal viscera, diseases of the urinary passages and kidneys, and in the uterine system in females. About five pints, divided into fourteen cups, are drunk at an average by each individual every day. Several hundred pounds of sulphate of soda are annually prepared from the water. The regular population of Carlsbad is about 3000; and in the years 1799 and 1800, about 3000 strangers came to take the benefit of the baths. E. Long. 12° 52′, N. Lat. 50° 14′ 58″. See D. Becher, *Abhandlung über das Carlsbad*, 1789, 3 vols. 8vo.; *Beschreibung von Carlsbad*, Prag.; *Carlsbad und die umliegende Gegend von Hubert von Harrer*, Prag. 1801, 8vo.; and Klaproth, *Recherches chymiques sur les eaux de Carlsbad*, Berlin, 1770, 8vo. (π)

CARLSCRONA, a sea-port town of Sweden, in the province of Blekingen, South Gothland. It derives its name from Charles XI. by whom it was founded in the year 1680, as a station for his ships of war. He removed them from Stockholm to this place, which was greatly preferable, both on account of the convenience of its situation, and the safety of its harbour. And it has continued ever since to be the grand, or rather the only, depot of the Swedish fleet.

The principal part of the town stands on a small rocky island, which communicates with the main land by a strong dike and two wooden bridges. The mole, too, which lies close to the bason where the fleet is moored, is covered with houses; and there are several little islands immediately adjoining, on which the more wealthy inhabitants have their country-seats and gardens. These suburbs are fortified towards the town by a stone wall. The town is extensive and spacious. Most of the houses are built of wood. There are a few tolerable ones of brick. The new town-house is a very handsome structure. The arsenal is a spacious and well furnished edifice. And of the churches, one or two are rather elegant, particularly the German church, which has been recently erected, and which has a cupola covered with copper.

The harbour of Carlscrona is very large and commodious, being capable of holding 100 vessels. It has depth of water sufficient for ships of the largest size carrying their lower tier guns; and it is perfectly protected, both by nature and art, from any hostile attack by sea. Before it are many shallows, and nearly 100 inconsiderable islands, which render the navigation quite impracticable to strangers. Ships of war, indeed, can only enter the harbour in one way, *i. e.* between the islands of Aspo and Turko, and these are furnished with batteries which completely command the passage. Formerly there was another way, but it has been shut up by sinking some frigates. There is still another entrance, but it admits of no vessels except those of light burden.

The new docks at Carlscrona give to this town its chief interest and importance. Originally ships, on undergoing repair, were laid on their sides in the open harbour. But in 1714, according to a plan of Polhem, whose mechanical skill is celebrated in Sweden, a dock of considerable dimensions began to be formed, by hollowing out the solid rock. This, however, though it was not finished till the year 1724, was found to be too small for men of war; and therefore it was afterwards enlarged to the capacity of receiving vessels of the first rate. In length it is 190 Swedish feet, in depth 33, and in breadth 46. When full, it contains 300,000 cubic feet of water, and is emptied by means of chain pumps, which require the labour of 90 men constantly employed for ten hours, and relieved every half hour. A dock so capacious, hewed out of the solid rock, was unquestionably a bold and grand undertaking; but it is far surpassed by the new docks which, in the language of Coxe, "have been begun upon a stupendous plan, worthy of the ancient Romans." According to the proposed plan, accommodation is to be provided for twenty ships of the line, which are to be kept dry, and under cover. As these ships were to run directly from the sea into the docks, it became necessary to erect vast works, by which the violence of the waves might be prevented from doing them injury. For this purpose, it was requisite to have a solid foundation for the walls and dams, and also for the places in which the vessels were to stand, and to provide these with gates of large extent, and great strength. The ground, in its natural state, was not favourable for the purposes to which it was to be applied, some parts of it being very low, and other parts of it very high. The latter, therefore, consisting of granite rocks, were removed by means of gunpowder introduced through hollow tubes; and the former were filled up with massy flat stones, cemented with puzzulana brought from Naples, and carefully reduced to a smooth surface. The form of the new docks is semicircular. From the centre to the circumference it is divided into four divisions, each division having separate receptacles for five vessels,—a distinct gate, 48 feet in breadth, and nearly thirty in height,—and a detached edifice over it, with a copper roof. The walls, like the bottom, are of hewn granite, about 40 feet thick, and filled up in the middle with earth; and the roof is supported by rows of granite pillars, which give it a very magnificent appearance. There is one common entrance for the five ships, which each of the principal divisions contains. The docks and buildings connected with them, are separated from the town by a lofty stone wall, remarkable for having been erected by the Russian prisoners captured by Charles XII. As this wall, which was intended to provide against the communication of fire, is found to be of no use, Admiral Chapman has ordered the upper part of it to be taken down, and the materials thus procured to be employed for raising more necessary structures. The progress which has been made in this vast undertaking, has not equalled the hopes and views that were entertained at the outset. It was begun in 1757; and 25,000*l.* were annually expended. The work, however, as soon as its novelty had ceased to interest, was much neglected. It was afterwards warmly patronized by Gustavus III.: But it was again allowed to languish. The annual expenditure was reduced to 6000*l.* Instead of finishing a dock every year, as was proposed and expected, nine or ten years were wasted in executing the first, after it had fairly commenced; and even now, of all the four divisions of which the plan consists, only one has been completed since the year 1761; and in this, not more than three out of the five docks are ready for use. Of the other divisions little more has been done than to exclude the water.

The ships at Carlscrona are built chiefly by English workmen. The provinces of Blekingen and Scone not affording a continued supply of oak, this sort of timber is partly imported from Germany. But masts, deals, pitch, tar, and the greatest part of the flax used in the navy, are procured from the Swedish territories. Ropes and sails are manufactured from Riga hemp. Cannon is cast, and gunpowder made with Swedish saltpetre. Carlscrona is the place of residence for the governor of Blekingen, and is the tenth in order of those towns which vote in the diet. It is one of the four places in Sweden in which the Jews were permitted, by a decree of the state, to erect synagogues for their peculiar worship. Of the population of Carlscrona different statements are given by different writers. Catteau, in his *General View*, &c. makes it only 9000; but in his *Travels in Sweden* he makes it about 12,000. Coxe says that it is about 18,000; Riechard, between 12,000 and 15,000; Tornquist, from 15,000 to 18,000; and Kuttner 12,000. But the most correct information on this subject is to be found in a work entitled Diurberg's *Beskrifning om Sverike*, vol. i. p. 188; in which the population of the principal towns in Sweden is given from the best authorities. Diurberg makes the number of inhabitants in Carlscrona, in the year 1800, to be 13,800. E. Long. 15° 26′ 15″, N. Lat. 56° 20′. See Coxe's *Travels in Poland, Russia, and Sweden, &c.* vol. iv.; Catteau, *Voyage en Allemagne et en Suede, &c.* tom. ii.; Küttner's *Travels through Denmark, Sweden, &c. in* 1798 *and* 1799; Diurberg's work, quoted above; and Malte-Brun's *Annale des Voyages, &c.* tom. iii. p. 332. (*τ*)

CARLSRUHE, or CARLSROUHE (signifying peace or repose of Charles), is a town in Germany. It is situated in the circle of Suabia, and marquisate (now electorate) of Baden, was founded in 1715 by the Margrave Charles William, and is now the residence of his successors, who have here a fine palace and delightful gardens. The plan on which the town is built is very regular; and it is also very singular, being in the form of a fan. There is a single street, about an English mile in length, running in a direction parallel to the front of the palace, and at a considerable distance from it. From this, all the other streets, amounting to thirty-two, go off at right angles, and are so arranged as to have their view terminating, at one end, in the front of the palace, while the other penetrates the forest by which the town is surrounded; and the houses are constructed with as much regard to uniformity as the streets, being all of equal size and height. The *coup d'œil* from the top of the palace is said to be extremely beautiful and magnificent. Of churches, there are four; two for Protestants, and two for Roman Catholics. There is also a Jewish synagogue. The literary establishments of Carlsruhe are chiefly these;—the Gymnasium Illustre; seminaries for educating village curates and schoolmasters; an institution for the deaf and dumb; and a type-foundry. There are here some collections of natural and artificial curiosities, which deserve notice. They consist of the library belonging to the Margrave; his physical cabinet; his cabinets of medals, of models, and of natural history; in which last, the collection of tulips is uncommonly fine. Besides these, there is a botanical garden; Gmelin's cabinet of natural history; Boeckmann's physical cabinet; and Becker's collection of prints. There is a charming promenade in the garden behind the palace, where there is a green-house that is reckoned the largest and finest in Germany. Many attempts have been made by the Margrave to introduce manufactures and industry into Carlsruhe, and he has had considerable success. He has induced several watchmakers from Geneva to settle in it, by granting them peculiar privileges; and many of the inhabitants, instructed by English mechanics who reside there, are engaged in steel manufactures, similar to those which are carried on in Birmingham and Sheffield. Meyer's work for grinding and polishing is deemed remarkably curious. The population is estimated at 10,000. See Reichard's *Guide des Voyageurs en Europe*, tom. ii. p. 57.; Stolberg's *Travels;* and *Briefe über Carlsruhe von Brunn.* (*τ*)

CARLSTADT, a town in Sweden, lying in the province of Woermeland, West-Gothland. It is situated on an extensive island, called Tingwalla, which is 12 miles in circumference, and is formed by the river Clara, dividing into branches, and afterwards uniting and falling into the Wenner Lake. It was built by Charles IX. in the year 1584. All the houses, excepting the cathedral and the school, are constructed of painted wood. The streets are broad and straight; there is a number of spacious buildings; and, upon the whole, it is a pretty place, having the agreeable features of cleanliness and cheerfulness to recommend it to the stranger's eye. It is the see of a Bishop, who has here an episcopal palace; has the 38th vote in the order of the diet; and, according to Diurberg, contains 1800 inhabitants. There is a mineral spring in its neighbourhood. It has manufactories of linen and woollen; imports sugar, tea, and spices; and trades in iron and wood across the Wenner. East Long. 13° 18′, North Lat. 51° 21′. See Coxe's *Travels in the North of Europe*, vol. iv.; and Küttner's *Travels through Denmark, Sweden, &c.* in 1798 and 1799. (*τ*)

CARMAGNOLA, a town of France, in the department of the Po, and formerly in the marquisate of Saluzzo, is situated at a small distance from the right bank of the River Po. In the year 1691, the French fortified this town with walls and ditches, and enlarged the citadel. The Fauxbourgs, which were too large, were demolished; and it was thus rendered one of the strongest places on the frontiers of Piedmont. The same number of Fauxbourgs were afterwards rebuilt at the distance of 500 paces from the town, and as large as the former. Carmagnola is situated in a fertile country, abounding in grain, flax, and silk; and its market is much frequented not only by the Piedmontese, but by the inhabitants of Dauphiny, Nice, and the country of Genoa. There is only one parish within the walls of Carmagnola, and four in the Fauxbourgs. The population of the town and Fauxbourgs amounts to 12,000. East Long. 7° 43′, North Lat. 44° 50′. See Tynna's *Almanach du Commerce, pour* 1811, p. 779; Denina *Tableau Historique, Statistique, et morale de la Haute Italie*, p. 17, Paris, 1805. (*w*)

CARMATHIANS, or Karmathians. See the article Arabia, vol. ii. p. 280.

CARMEL, a celebrated mountain in Palestine. Though spoken of in general as a single mountain, it is in fact rather a mountainous region, the whole of which is known by the name of Carmel, while to one of the hills more elevated than the rest, that name is commonly applied by way of eminence. It has the plain of Sharon on the south; overlooks the bay of Acre on the north; and is bounded on the west by the Mediterranean, forming one of the most remarkable promontories that are to be seen on the shores of that extensive sea. John Phocas, a Greek monk, who visited Mount Carmel in the twelfth century, describes it as having the form of a ridge, extending from the bay which winds by Ptolemais and Caiphas, to the Galilean territory. Josephus says, (*de Bell.* l. iii. c. 3.) that Carmel was a mountain of Galilee. In another place, (*Antiq.* lib. v. c. 1.) he states that Issachar, in length, had for its limits Mount Carmel and the river; and that the tribe of Zabulon's lot included the land which belonged to Carmel and the sea. Theodoret (*Comm. ad* c. 32. *Jesaiæ*) places Carmel in Samaria. Hieronymus (*In Comment. ad Jes.* 29.) describes it as situated on the confines of Phœnicia and Palestine, and overlooking Ptolemais. In a passage of the 4th vol. of Hudson's *Minor Geographers*, it is represented as lying immediately to the north of Dora. It belonged to the tribe of Asher and Manasseh, according to the division made by Joshua of the Holy Land. (See *Josh.* xix. 26. Reland. *Palæst. Illust.* tom. ii. p. 539, and Calmet's *Dictionary*.) St Jerome informs us, that this tribe having remained in captivity with the other tribes, Carmel returned into the possession of the Phœnicians, its original masters. It is, according to Volney, about two thousand feet in height. It has the shape of a flattened cone. Its sides are steep and rugged. Its soil is neither deep nor rich. And among the naked rocks, stinted plants, and wild forests which it presents to the eye, there are few traces of that fertility which every reader of scripture naturally associates with the idea of Mount Carmel. Yet even Volney himself acknowledges, that he found among the brambles, wild vines and olive trees, which proved that the hand of industry had once been employed on this ungrateful spot. Of its ancient productiveness there can be no doubt; the etymology and ordinary application of its name being sufficient evidence of the fact. Carmel is not only expressly mentioned in the sacred writings as superior to other districts in that respect; but every place possessed of the same kind of excellence, obtained from it the same appellation, in the language both of the prophets and the people. Some accordingly suppose that Carmel was primarily the name of the mountain, and that on account of its natural or superinduced fertility, the name came to be transferred to all places that were distinguished by a similar character; while others think, that as the original signification of the word Carmel is a fertile place, the mountain in question got that appellation from its peculiar and acknowledged fertility. We shall not attempt to determine which of these opinions is the most correct—Ben David himself declines the task, on account of its difficulty—but each of them implies a testimony to the ancient fruitfulness of Carmel. And it is curious, that the words of which that name is compounded, as well as the name itself, refer not only to the general quality ascribed to Mount Carmel, but even to the particular kinds of produce in which that quality appeared. Thus כרה signifies to cut off, to prune, מל or מלא to fill, כרם, a vine, and כרמל, a full ear of corn, a fruitful field or country, a place planted with fruit-trees. The word Carmel also signifies purple or crimson; because at the foot of the mountain, on the south side, a certain shell-fish was caught which was of great use in dying that colour. See *Song of Solom.* vii. 5. and also Bochart *de Animal Sac. Scrip.*

Mount Carmel is celebrated in scripture as the abode of Elijah and Elisha. It was here that Elijah opposed so successfully the false prophets of Baal; (1 *Kings* xviii.) and there is a certain part of the mountain facing the west, and about eight miles from the point of the promontory, which the Arabs call Mansur, and the Europeans the Place of Sacrifice, in commemoration of that miraculous event. Here also, near the same place, is shown a cave, in which it is alleged the prophet had his residence, and in which, according to Phocas, "that wonderful man, after he had spent an angelic life, was translated into heaven." There is a small spot, too, which tradition represents to have been his garden. Mariti observes, that the prophet seems to have inhabited successively every part of Mount Carmel; for almost all the fields, grottos, and fountains, are still called by his name. On the summit of the mountain there is a chapel dedicated to Elijah, which commands a most extensive and delightful prospect. It is certain that Mount Carmel very early began to be an object of great veneration among both Jews and Christians, and that those parts of it which were particularly hallowed by his presence, have been always regarded by them with the most pious emotions. Chateaubriand gives an animated account of the impression made upon his own feelings and on those of the pilgrims who accompanied him, by the first view which they got of it. (See his *Travels*, p. 358.) And we are told that even the Mahometans, forgetting their principles and their prejudices, participate occasionally in the reverence which is felt for Mount Carmel, and invoke the images of the Virgin and Elijah, which are worshipped there in the Carmelite church.

Carmel is mentioned in profane history. Suetonius tells us, that Vespasian, when he went into Syria to subdue the Jews who had revolted, ascended this mountain to offer a sacrifice to the deity of the place, and to consult the oracle as to his future fortunes. Tacitus, (*Hist.* l. ii. c. 78.) in relating this fact, states, that the name of this deity was the same with that of the mountain; that there was no image or statue of him, and no temple erected for his worship; and that there was only one altar, on which sacrifices were devoutly offered to him Jamblichus, however, in his life of Pythagoras, speaks of a temple there, to which that philosopher frequently resorted, for the purposes of solitary meditation. In the writings of Scylax, who, according to Gronovius, flourished in the reign of Darius Hystaspes, and whose geographical notices have been much restored by the labours of the learned Vossius, we read of Carmel as "the mountain and temple of Jupiter"—"Καρμηλος ὀρος και ἱερον Διος." There is a book written by Mendoza a Spaniard, and translated into Latin by Papenbrochius, which treats particularly of the god Carmel, and contains many things in proof or illustration of this point.

The order of the Carmelites has its name from this mountain, and, if we may believe some of themselves, takes its origin from the prophets Elijah and Elisha. Phocas, already quoted, gives an account of their origin as rational as any other. In 1185, when he was at Carmel, he tells us, that there still existed the remains of a large monastery, which time and violence had reduced to ruins; and that a few years before, one Berthold, an aged Calabrian priest, instructed, as he said, by a revelation from the prophet, erected a small temple or chapel, and having collected about ten brothers, took up his abode in that holy place. He was in this situation when Phocas was there. These Carmelites, in 1205, got a very rigid rule from Albert the patriarch of Jerusalem; which, in 1226, was confirmed by Pope Honorius III. and afterwards mitigated by Innocent IV. In 1229, they left the Holy Land under Alan, the 5th general of the order. Some of them were sent into Cyprus in 1238; some went to Sicily; and some were brought by St Lewis into France. They came into England in the year 1240, and erected a great number of monasteries. In the 16th century, they divided into two branches, viz. Carmelites of the ancient observance, and Carmelites of the strict observance, or bare-footed Carmelites, which separation was confirmed in 1587 by Sextus V., and completed in 1593 by Clement VIII. The Carmelite order has always been eminent for its missions, and for the great number of saints with which it has furnished the Romish calendar. Its members received from several of the popes the title of Brothers of the Blessed Virgin.

On the mountain, the Carmelites have still a convent, which is almost wholly indebted to nature for its construction and accommodations. It has a small chapel, containing two altars, one of which is consecrated to the Virgin Mary, and the other to Elijah. Two priests and two Carmelite laics are here almost constantly at prayer. There are several cells and apartments destined for the use of travellers, and for the French inhabitants of Acre, who come hither sometimes for the benefit of the air. They are under the protection of the consulship of Acre, and depend upon the charity of the Mahometans, who esteem them for their exemplary life. The ruins of the monastery formerly mentioned, which are as thick as the walls of a fortress, and have every appearance of solidity, hang over the cells of these Carmelites, who, afraid of being buried under them, an accident not unlikely to happen, have taken a great part of them down. Some of the grottoes have been converted by the Mahometans into a mosque, under the title of El haden, *the green*, in which a dervise, who with his family lives in a neighbouring hut, regularly performs divine service. Between this place and the convent of the Carmelites, along the whole declivity, there is a great number of cisterns, some of them very spacious, intended to hold the rain water which is collected during winter for the use of the monks. Most of them are now insufficient for that purpose, but there are some excellent springs at a little distance, which supply their place in the summer time or dry season. From one of these flowed a stream which passed along a canal cut out of the rock, and after turning a mill lost itself in the sea. Both canal and mill are now destroyed, and the stream is applied to no useful purpose. From the foot of the mountain proceeds the lake Cendevia, out of which flows the Belus, a river mentioned by Pliny, Tacitus, and Flavian, as famous for having its sand richly intermixed with glassy particles. This sand is taken away by foreign vessels as ballast; and from it were manufactured those fine plates of glass with which Venice long supplied the European market. The brook Kishon, which issues from Mount Tabor, waters the bottom of Carmel, and falls into the sea towards the northern side of the mountain, and not the southern, as some have erroneously alleged.

On Mount Carmel there are the remains of many magnificent buildings, which are calculated to give a grand idea of what they once were. Mariti tells us, that he saw the vestiges of many convents, and some most beautiful columns of oriental granite. According to Pliny, (*Nat. Hist.* l. v. c. 19,) there was once a town here anciently called Ecbatana, and more recently named Carmel. Scarcely a relict of it, however, was to be seen in his time. The Arabs did much to destroy the edifices on Mount Carmel, the materials of which they transported to Damietta, where there were no stones fit for building. At one part of the mountain there is a field called the *Field of Cucumbers*, because it contains a great many round stones, the inside of which being a sparry substance, resembles the pulp of that fruit. Djezzar, the pacha of Acre, under whose immediate dominion Carmel is situated, told Dr Clarke, that on this mountain "he had found several thousand large balls, and never could discover a cannon to fit them." Dr Clarke supposed, that by these balls the Pacha meant the mineral concretions of a spheroidal form alluded to above, and that being in want of ammunition, he had determined to make use of these stalagmites. (Clarke's *Travels in various Countries*, part ii. p. 388.) It is a fact mentioned by Maundrell (*Journey from Aleppo to Jerusalem*,) and by Egmont and Heywood, (*Travels through part of Europe, &c.*,) that large stone bullets have been employed, with the help of some military engine now unknown, for the purpose of battering the besieged cities. And Mariti mentions, that "abundance of the same kind of stones may be found in all the mountains of Syria."

Mount Carmel has a great variety of plants growing on it, for the sake of which it has been occasionally resorted to by botanists with considerable success. Besides some rare plants, it produces, without cultivation, sage, rue, wormwood, hyssop, lavender, and parsley. It also produces fine flowers, such as hyacinths, anemones, tulips, and ranunculusses. It abounds in fowls of different kinds, on which account it is agreeable to sportsmen, who will also meet with various quadrupeds, wild boars, lynxes, &c. Mariti says that he saw some tigers. See Relandi *Palæstina Illustrata*; Egmont and Heywood's *Travels through part of Europe, &c.* vol. i.; and Abbé Mariti's *Travels through Cyprus, Syria, and Palestine*, vol. ii. c. 4. (τ)

CARMONEA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 172.

CARNATIC, is a narrow stripe of country on the eastern side of the peninsula of India, which anciently comprised all that part of it that lies south of the Gondegama and Tungebadra rivers, from the coast of Coromandel eastward, to the Ghaut mountains westward; and was divided into Balla-Ghaut and Payen-Ghaut, or the Upper and Lower Ghauts, (that is passes through mountains), the former being the western part, and the latter the eastern part, or the Carnatic, according to its present definition.

From the intercourse, however, which has subsisted between Europeans and the inhabitants of the Carnatic, in the way of mercantile speculation, and the numerous wars by which that fine country has been infested, we are as well acquainted with this part of Indostan as any other district of our immense possessions in India.

The Carnatic, in general, is even and dry, and presents a sameness of appearance, of which those who have only had an opportunity of traversing regions that are mountainous, can scarcely form any adequate idea. In the hot season, the dreariness of the prospect forcibly strikes every traveller. He has nothing to amuse or to withdraw his attention from the labours which necessarily accompany the fatigue of his journey, but a naked, brown, dusty plain, and now and then small villages, and a ridge of detached hills. The sameness of the appearance of the whole district of country, seems to have impressed every one who has had the curiosity to visit it. In the rainy season, however, a most remarkable change takes place, and the inhabitants of those tropical regions, so fertile, that the produce of the earth seems to be almost spontaneous, are subjected to greater and more sudden transitions, in regard to climate, than those who live in countries where more labour is requisite for the cultivation of the soil. Those alterations are indispensibly necessary for promoting vegetation, and the natives consequently look forward to the change with the utmost eagerness and anxiety.

An immense ridge of mountains, extending 13 degrees of latitude, that is, from Cape Comorin to Surat, produces the most important effects in regard to the nature of the seasons, not in the Carnatic only, but throughout the whole peninsula. Although the altitude of these mountains is unknown, yet it is sufficiently great to prevent the great body of clouds from passing over them; and, accordingly, the alternate N. E. and S. W. winds (called the monsoons) occasion a rainy season on one side of the mountains only; that is on the windward side. It would appear, nevertheless, that a sufficient number of clouds pass over to occasion a rainy season, at a considerable distance to leeward, where those clouds descend, as we may suppose them to do; although at the time they passed over the Gauts they must necessarily have been too high, and of course too light, to condense and fall in rain there. The ridge of the Gauts shelters a particular tract only, beyond which, the light and elevated clouds that pass over it descend in rain. Madras is within the limit of the sheltered tract, though at least 300 miles to leeward of the Gauts. (See Rennell's *Memoir*.)

Though an immense number of rivers intersect India in every direction, yet the Carnatic, properly so called, is worse supplied with such as are navigable than almost any country of equal extent. This no doubt operates as a powerful barrier towards promoting the facilities to commerce, and consequently to the progress of manufactures, which it would otherwise have enjoyed. Little or no internal navigation can be carried on, and the difficulty of transporting goods from one place to another must be severely felt. All the rivers on the coast of Coromandel are subject to very sudden and unforeseen alterations, which are occasioned by the rains that fall on the mountains. In the space of twenty-four hours, it often happens, that from being fordable, they become almost impassable even by boats, on account of the rapidity of the current. Considerable inconvenience to the inhabitants is the certain effect of the suddenness of so great an increase, but this is greatly counterbalanced by the genial influence which these overflowings have upon the soil, from which they must derive their subsistence. In a tropical country, the heat is so excessive, that the ground is quite parched; and had not nature made the wise provision of periodical rains, common to every region of the same latitudes, vegetation could never take place: it must soon have become altogether uninhabitable, because incapable of affording sustenance to man or beast.

There are only three rivers in the Carnatic, properly so called, which it is necessary to mention in this place. The Paliar runs past the cities of Vellore, Arcot, Conjeveram, and Sadras. At the last mentioned place, it is extremely broad, and discharges itself into the sea. About the middle of October, when the winter commences, and the rain pours down in torrents, it is sometimes half a mile broad, and flows with the utmost violence and impetuosity. The second, named the Chonenbar, falls into the sea on the south of Pondicherry, after having united, not far from that city, with the Gingee. The third is called the Pannar, or the Golden River. It has its source in the Gauts, not far from Darampuri in Mysore, runs past Tricalore, and on the north of Cuddalore throws itself into the sea.

It is a singular circumstance, that the coast of the Carnatic forms nearly a straight line, and that it has no port for shipping. It is also incommoded with a high and dangerous surf or wave, that breaks upon it, and induces the necessity of using the boats of the country to land in. These are called *massoolah*, and are of a singular construction, being formed without ribs or keel, with flat bottoms, and having their planks sewed together, iron being totally excluded throughout the whole fabric. By this construction they are rendered flexible enough to elude the effects of the violent shocks which they receive, by the dashing of the waves, or surf on the beach, which either oversets or breaks to pieces a boat of European construction. The sides of these boats are raised remarkably high, and sewed together with the fibres of the cocoa-nut tree, and caulked with the same material. They are remarkably light, and are managed with great dexterity by the natives; they are usually attended by two cattamarans or rafts, paddled by one man each; the intention of which is, that should the boat be overset by the violence of the surf, the persons in it may be preserved. No port for large vessels occurs between Trincomalee, on the east side of Ceylon and the Ganges, which is an extent of 15 degrees.

The coast of Coromandel has, at a distance, the appearance of a green theatre, when the season is favourable. The sea-shore is covered with white sand; and a multitude of beautiful shells are occasionally to be seen. The land is covered to a considerable distance, with a great variety of trees, and particularly that called by the Europeans the real Indian palm, or the cocoa-nut tree.

The natives call it tenga, and make much use of it in embellishing their gardens. A great number of these are planted on the coast, interspersed with hamlets and villages, and afford a most delightful prospect to the spectator.

The maritime cities and towns of the Carnatic are Cuddalore, Pondicherry, Portonovo, Sadras, St Thomas, Madras, and Pullicate, and a few others of lesser note. Cuddalore is naturally a very strong situation, a circumstance of great importance formerly, when war was so frequently carried on in India, and would certainly have been more commodious for the British settlement than Madras, at the time that the French were in possession of Pondicherry. The Dutch formerly possessed the towns of Portonovo, Sadras, and Pullicate; but the valour of the British arms has wrested these from them, and rendered us independent of the rivalship of any European power on the eastern coast of India. St Thomas is from three to four miles to the southward of Madras, and here there was formerly a considerable Portuguese settlement. Madras, or Fort St George, is close on the margin of the sea, and is the principal settlement of the British East India Company on the east side of the peninsula.

The nominal capital of the Carnatic is Arcot, the residence, or rather which was formerly the constant residence of the nabob of that name. From the dependent state of its old possessor, and the obligations under which he lies to the British government, it has lost much of that splendour and luxury of a court, by which it had been so long distinguished. All the towns throughout the whole Carnatic, are exceedingly exposed to the attacks of an enemy's horse, from the level nature of the country. This has rendered it an object of indispensible necessity to erect forts, and to improve the situation of the place, and in general to remedy the disadvantages of so dry, open, and unprotected a territory. Accordingly the fortress at Madras, called Fort St George, is of very great strength; including within it a regular, well built city. Upon any sudden incursion of the enemy, (as in 1780), the inhabitants of the country flock to these fortified places, and carry along with them their families, and what little property they can conveniently collect. The instances of the most excessive cruelty that have occurred in the Carnatic wars, have not been confined to its Mahomedan conquerors; for so late as 1761, Pondicherry, the finest city in India, together with its citadel, was razed to the ground. From the complete subjugation of the native princes, and the ascendency of the British arms, it is not considered at present as of any importance to keep in constant repair any forts in the Carnatic, excepting those that are on the sea-coast, or command some of the great roads leading into it. Thus the fortress of Arcot is in bad repair, although the nabob maintains a garrison of his own troops in it; whereas that of Vellore, being a post of great importance, and the most direct route from the country of Mysore, is justly deemed impregnable to an Indian army.* It consists of three strong forts, on as many hills. That part of the Carnatic which more peculiarly belongs to the East India Company, is called *Jaghire*, a term which generally means, a grant of land from a sovereign to a subject revokable at pleasure, but in most instances for a life rent, neither of which apply to that under consideration. It contains 2440 square miles, and, according to Rennell, its revenue is reckoned at about 150,000*l.* per annum. This tract of country extends from Madras to the Pullicate lake northward; and to Alamparué, southwards; and westward, beyond Conjeveram; that is about 108 miles along shore, and 47 inland, in the widest part.

The inhabitants of the Carnatic, particularly upon the sea coast, consist of an immense variety of different tribes of men. This has arisen, no doubt, from the marketable nature of the commodities which it has produced in every age, and the consequent opportunity that was afforded to adventurers to acquire wealth, one of the leading pursuits of the generality of mankind. The population of the whole district has never been accurately ascertained. The city of Madras itself is extremely populous, and the strange medley of which it consists, is well calculated to convey a just idea, though upon a large scale, of the variety of inhabitants in the rest. None are permitted to reside in Fort St George but the English, and it is called the White town; but the outer district is inhabited by Europeans, Armenians, Bengalese, Chinese, Peguans, Arabians, Jews, and black and white Indians, of all classes and religious sects, &c.; it is called the Black town.

It would be improper to enter here into a long detail respecting the different races of men, their dress, customs, manners, peculiar institutions, or religion, as a full exposition of those different particulars will be given under the article INDIA. It may be necessary to observe, however, that throughout the whole of India, a very great similarity exists in all these respects. They have very generally been arranged under Hindoos. Mahomedans, and Christians; their religion conveying a pretty accurate idea of the tribes which compose those different orders. The complexions of the people on the coast of Coromandel are considerably darker than those to the northward; and the native Hindoos are generally darker than the Mussulman, who originally came from Tartary and Persia. They all wear white cotton dresses, and made almost in the same manner. To distinguish the Hindoos, therefore, you must look very closely at their forehead or breast, because they have certain marks which they consider as sacred, and by which it may be discovered to what sect they belong, and what Deity they worship.

It is well known, that the Hindoos are divided into *casts*. Four of these are esteemed pure: that of the Brahmins, the Kshatriyas, the Vaishyas, and the Sudra. Every other member of the community, who is not connected with one or other of these, is reckoned impure. The divisions of the first class, however, in the Carnatic, are different from what they are in Bengal. They are divided into three sects, and though they admit the divine authority of the same purans or religious books, they interpret them differently, and have each their followers. They consider the second class as having been quite extinct for many centuries. Another very singular difference also exists in this country, *no Brahman* officiates in any of the temples of the inferior gods, whose altars are stained with blood.

The food of the natives of India is well known to be very similar throughout the whole continent. A vegetable diet and milk constitute the whole of it. In so extensive a tract of country, it must naturally be expected that a difference of taste will exist. The *tari*, or fermented juice, and the *jagory*, or inspissated juice of the *palmira* tree, (*Borassus Flabelliformis*,) are more esteemed in the Carnatic than those of the wild date, to which the Bengalese give the decided preference. They pretend to be very moderate in the use of the *tari*, but consume great quantities of the *jagory*. It sells in the country for about nine shillings and five pence per hundred weight. The people who make *jagory* from palm trees, follow no other profession. The cast is called *Shanar*, but the individual in the Tamul language is *Shanan*. He ascends the palmira tree morning and evening, in order to collect the exuded juice, and through the day he and his family boil it down into jagory. The tree produces at all seasons, and one man can take care of 200 trees, from which he can extract abont 482 pounds of *jagory*.

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* Vellore was chosen for the residence of the family of the late Tippoo Saib.

A great variety of languages are spoken in the Carnatic. The Tamul, the Hindostannee, the Persic, and the Arabic, &c. Many of the names of remarkable places and objects (*e. g.* the word Ghaut,) are of Arabic extraction, or at least are to be found in that language. Whether these words were borrowed in the same manner, as we in modern times borrow the names of arts, sciences, &c. from the Greek, or from what other cause it proceeded, it would be presumptuous to affirm positively. Similarity of sound, even when accompanied with identity of meaning, is an exceedingly uncertain foundation upon which to assert a priority of claim upon the one side or the other. The early literature of the natives of India, as well as their knowledge of the more abstruse sciences, have been frequently the subject of panegyric. The inhabitants of the Carnatic have laid claim to a considerable share of the fame which they conceive their ancestry to have acquired in the cultivation of learning, and in the opinion of competent judges have made good their title. It would be idle to launch into the regions of uncertainty, upon a subject which the hand of time has now consigned to impenetrable darkness. One thing, however, seems to be placed beyond the shadow of doubt, that, at a period how remote soever, the sovereigns of the Carnatic must have been possessed of great wealth and power, and the country in general must have made extraordinary advances in population, industry, and in the arts, before they could have left so magnificent monuments of their architectural profusion and skill. The number, variety, extent, and elegance of their pagodas and other public buildings, cannot be exceeded, and scarcely equalled in nations that have attained to a very high degree of civilization. The duration of those remains of ancient grandeur has been accounted for, or at least attempted to be accounted for, from the nature of the cement employed in building in India, (it is composed of a mixture of oil and viscous substances,) and from the nature of the climate.

It is perhaps impossible for an European to judge of the true genius of Indian poetry, or to enter, with the spirit of an Asiatic, into the productions of their bards. The superiority of the knowledge of the language, aided by many fabulous traditions which the natives consider as canonical, render them much more inclined to peruse, with enthusiasm, the works of their favourite authors. Their painting, it must be confessed, bears little or no resemblance to nature; and of their music perhaps no high encomium can be pronounced. Dr Buchanan remarks, "that the music of the *Nabut*, or state band of the nabob of Arcot, is much superior to any thing he had ever heard among the natives, and is not much harsher than our clarionet."

The first and the most important of all arts is that of agriculture, and civilization can have made but very inconsiderable progress where it is not cultivated. Mankind have a powerful stimulus to employ every exertion, in order to increase the means of subsistence. The degree of exertion, however, which is actually made, depends upon many adventitious circumstances, such as the climate, the soil, the spontaneous productions of the earth, &c. The progress of agriculture in the Carnatic has been very small, like that of every other country in India. It may be said to have been stationary for ages The soil in many places is fine, and, when the proper quantity of rain falls, requires very little labour to produce a most abundant crop. In others the soil is very indifferent. Rocks, or large detached masses of granite, are very common in many fields, even in those districts that are considered as the most fertile. In other places, again, there are immense beds of granite, or of that rock decomposed into harsh coarse sand. Many of the hills are composed of the same substance, which alone renders cultivation totally impracticable. From the intenseness of the heat of the climate, even the best and most favourable soils require a very great quantity of water, in order to promote vegetation. Nature most commonly supplies abundance of this necessary manure in the rainy seasons, and in that case two crops are produced. If this be withheld, scarcity, and even famine, is the certain consequence. The natives, however, have attempted to provide what is, in a small degree, a substitute for this invaluable blessing. Throughout the whole of India, what is called *tanks*, or reservoirs of water, have been formed. In Bengal, this is generally effected by digging; but in the Carnatic, where the situation is more favourable, they shut up, with an artificial bank, an opening between two natural ridges of ground. Some of these *tanks* extend from seven to eight miles in length, and three in breadth; and are said to be sufficient to supply with water the lands of thirty-two villages for eighteen months, should the rains fail. In the villages thus watered by *Saymbrumbacum* tank, there are 5000 persons employed in agriculture. But the bounty of Nature renders this seldom necessary. The water which is collected is generally employed in the dry season, and let out in small streams, without the aid of machinery, as wanted for cultivation. The genial nature of the soil and climate, assisted by moisture, is all that is requisite to produce the most luxuriant crop. When the water of a *tank* is exhausted before the rice of the fields watered by it is ripe, the crop must either perish, or they must use the *yatam*, or, as the English call it, the *pacota*. One acre and nearly one-fifth, require the constant labour of four men to supply it with water for the cultivation of rice. The same number of men are able to water three times the same quantity of garden ground, because a smaller supply is required. When there is a necessity for watering by machinery, a deduction from the rent is generally allowed. The machines are exceedingly rude, and discover very little enterprize or knowledge of the mechanical powers in those who have for ages employed them.

The instruments of husbandry are of the same rude construction; and were it not for the excellence of the soil and climate, they never could dress the ground so as to render it capable of producing what could indemnify the labour bestowed upon it, or even support the labourer himself. It is not the want of an inventive genius, to which we ought to ascribe the small progress that they have made in improving the instruments employed by them. There are few inventions in the arts that have not been dictated by necessity, and have, either in imagination or in reality, been considered as contributing to that love of ease which is so natural to man. Every implement of husbandry they make use of would be totally useless in a different region of the earth. The spade, hoe, harrow, and plough, are equally bad, and scarcely deserve the names. The great additional labour which thus devolves upon the husbandman is inconceivable; but custom and ancient usage reconcile them to any thing.

In the Carnatic, the greater part of the Brahmans engage in secular professions. Besides being officers of the revenue, and employed in administering justice, &c. they rent a great deal of land, but they never put their hand to the plough. Two unfortunate and miserable races of men are doomed to discharge this laborious duty. These are the Sudra and Panchum Bundum. The latter are by far the most hardy and laborious people of the country; and Hyder discovered his sagacity, when he shewed them such particular marks of his preference, as to settle them in many parts of his dominions as farmers, and interdicted his subjects from calling them by any other name than that of *cultivators*. There are a few Mussulmen who cultivate their farms by means of slaves, but they are not numerous in this part of Hindostan. Some of the Sudra cast, who have acquired a little property by their industry, have also purchased slaves, whom they employ in agriculture; but in general their lands are cultivated with their own hands.

The staple grain of the country is rice. It forms the favourite beverage of the Hindoos, whose religion forbids them the use of animal food; and their agriculture is chiefly directed to its production. They bestow also considerable care on the cultivation of maize, the sugarcane, and cocoa-nut tree. The wheat that is raised, whether from the climate or injudicious treatment, or from both, scarcely deserves to be mentioned. The cotton-tree, however, is widely diffused, and in no part of India does it thrive better than on the dry coast of Coromandel.

The narrow policy of the proprietors of the ground has produced very injurious effects in many parts of India. Thus, when the tenant is unable to pay his rent, it is usual in Bengal to prevent the crops from being cut down. In the Carnatic, however, the custom is to collect the grain in stacks, or heaps, after it has been thrashed out in the field. To guard against embezzlement, several pieces of clay stamped with a seal, are then put on the surface of the heap; and to prevent injury from the weather, it is thatched. The grain continues in these heaps till the cultivator is able to satisfy the renter, either by advancing money, or by dividing the produce. In every village a particular officer, called *talliari*, keeps watch at night, and is answerable for all that may be stolen. See Buchanan's *Travels*.

There are no markets in the Carnatic, similar to the fairs or *hauts* of Bengal. The shopkeepers purchase what they have occasion for from the farmers and manufacturers, and retail the articles thus procured in the *bazars*, or towns. Milk, a favourite beverage, is sold in all its different preparations by women on the road side.

The animals in the Carnatic are nearly the same as are to be found in the other countries of Hindostan. It would exceed our limits even to attempt an enumeration of them. These shall be noticed under the article INDIA.

The roads through the Carnatic are in general tolerably good. That from Pondicherry to Madras is excellent. In many places it is bordered by bushy trees, under the shade of which the traveller is protected from the scorching heat of the sun. Every two or three miles there are *choultries*, or taverns, in which comfortable accommodation may in general be obtained. Of these, however, there are two sorts; one for the convenience of travellers, and another for the reception of those images that may happen to be carried in procession. If not occupied by their idols, persons of all descriptions are admitted into them. These charitable foundations bear a great resemblance to institutions in the Romish church, and to the caravanseras in Turkey and Persia. The accounts given by different authors of the hospitality of the natives of the Carnatic are very various. They run into extremes; and perhaps a whole people have been characterised only from the comparatively few individuals with which they may have each happened to have had intercourse.

The manufactures of the Carnatic are chiefly those of cotton, which is wrought into an immense variety of different articles. From the earliest times, the Hindoos have excelled in this species of manufacture, and for ages supplied the whole of Europe, a great part of Asia, and the shores of Africa upon the Mediterranean and the Red Sea, with cotton goods, whether for the purposes of dress, or of household furniture, &c. Madras and Pondicherry have always taken the lead of all the other towns and cities on the coast in regard to commerce. The foreign trade was formerly partitioned principally among the Portuguese, the Dutch, the Danes, the French, and English. The latter, however, have at present a monopoly of the whole trade with India. What is called the country trade, is carried on in ships, the property of merchants who reside on the spot.

There is a very great difference in the value of the coin used in the Carnatic, as well as in other parts of Hindostan. The East India Company have, however, co-operated with the natives in bringing the weights and measures to a much greater degree of accuracy; and in the Jaghire they are permanently fixed. See *Rennel*, *Bartolemeo*, *Buchanan*, *Sonnerat*, and *Hodges*; see also the articles INDIA, MADRAS, and PONDICHERRY. (H)

CARNEADES. See the article ACADEMICS.

CARNICOBAR, the northernmost of that cluster of islands in the bay of Bengal, called the Nicobars. It is about 40 miles in circumference, of a circular figure, and elevated little more than six feet above the level of the sea. So much does it abound in wood, that at a distance it appears to contain nothing else, though there are several spots upon it well cleared, and very delightful. The trees are chiefly the barriongtonia, cocoa nut, tournefortia, borassus, and areca; the aletris fragrans, and various other shrubs, are to be met with: nuts of different kinds, pine-apples, plantains, limes, &c. are produced in great plenty: there are also wild ginger, excellent yams, and a root which the natives call *cachu*, and which is obviously a species of arum. All these grow abundantly, and with very little care, the climate being genial, and the soil rich. Lord Valentia, however, when he visited the island in 1802, could get no yams, and did not see a single pine-apple. The timber, which is plentiful, affords excellent materials for building and repairing ships, and some of it is of very large dimensions. No grain of any sort is produced on the island. There are great numbers of pigeons, poultry, and pigs. The latter are of the species called *sus babyrussa*. It is probable that now there are also goats, as Lord Valentia left a male and female of that useful animal, of which the natives promised to take great care. The other quadrupeds are dogs, rats, and a large animal of the lizard kind, called by the natives *tolongui*. Serpents are numerous, and their bite is frequently fatal to the inhabitants.

The houses, or huts, in this island, are generally erected upon the beach, which is sand, intermixed with coral rock; and form villages, each consisting of fifteen or twenty of them, and every house containing a family of about twenty persons. They are of a round shape, elevated upon long wooden pillars, covered with thatch, and having no windows, so that they very much resemble bee-hives. The entrance to them is by a trap door below, and the inhabitants mount by means of a ladder, which is drawn up at night. For the admission of light and air, the flooring is made of thin slips of bamboo, laid at certain distances. The inside is finished off with neatness, and usually decorated with nets, fishing lances, and other implements of that kind. The inhabitants sleep in little hammocks made of matted grass, or the rind of trees; the males on one side, and the females on the other. To prevent the rats, and especially the snakes, from getting in, the pillars on which the houses stand, are covered with a very smooth sort of leaf; and still farther to increase security, there is a flat broad piece of wood made to project from each pillar, near the top of it, which it is impossible for the noxious animals to pass.

The inhabitants of Carnicobar, though of small stature, are well made, very muscular, uncommonly active, and in general healthy. Their complexion is of a copper colour, and their features have a resemblance to those of the Malays, excepting that their noses are not so flat. They have large mouths and irregular teeth, which the practice of chewing betel renders black and disgusting. The men have their hair cut short, while the women have their heads shaved quite bare. Both sexes get their ears pierced when very young, and contrive, by squeezing large pieces of wood into the holes, and suspending heavy weights from them, to render them hideously wide, and very disgusting to the eye. From the accounts which have been given of them, it would appear that their countenance is far from being handsome or elegant. The women, in particular, Mr Hamilton says, are extremely ugly. Lord Valentia, however, tells us, that their features, though the very reverse of beautiful, have a pleasing expression. Though fond of European apparel when they can get it, their native dress has all the simplicity of savage life in a warm climate. The men wear nothing but a narrow strip of cloth wrapped close and tight about the middle. The women have only a short petticoat made of rushes, or dry grass, reaching half way down the thigh, and hanging round them like the thatching of a house. They speak a mixture of broken English and barbarous Portuguese, which Lord Valentia tells us prevented him from having any difficulty in communicating with them. But their original tongue is that of Pegu, from which the Nicobar islands were peopled; though their frequent intercourse with strangers has made them in a great measure renounce or forget it. They have this peculiarity in their utterance, which is the principal feature that they have retained of their native language, that they pronounce their words with a sort of stop or catch in the throat, at every syllable.

In eating and drinking, they go to great excess. Their favourite food is pork, which, with them, is remarkably fat, and of which they devour immense quantities at their village feasts. They like to sit at table with Europeans; and they eat every thing that is set before them with the most voracious and indiscriminating appetite. As might be expected, they are by no means nice in the cooking of their victuals. Their pork gets nothing more than a hasty grill over a quick fire, and is swallowed by them almost raw. Their method of roasting a fowl, is by running a wooden spit through it, and holding it over a brisk fire till all the feathers are burnt off, when it is quite prepared to their taste. They also make use of small shell fish, of which they have great plenty, and which they kill by means of lances, with wonderful dexterity. Their drink consists of cocoa nut milk, and a liquor called *soura*. The *soura* is a juice which exudes from the cocoa-nut tree, after cutting off the young sprouts or flowers, and, being allowed to ferment, acquires an intoxicating quality. This they suck slowly through a small straw, which method of taking it, increases its power of inebriation. They are also very fond of arrack, which they obtain in presents or by barter. They will continue drinking bumpers of it till they are completely drunk. Besides feasting, in which they take great pleasure, their chief amusement is dancing. After eating, the young men and women, fancifully dressed with leaves, engage in this exercise; while the old people sit around them, smoking tobacco and drinking soura. The only musical instrument which they have on such occasions, is made of a hollow bamboo, about 2½ feet long, and 3 inches in diameter, along the outside of which, from end to end, a single string, made of the threads of a split cane, is stretched, with a hollow groove immediately under it, to prevent it from touching. The instrument is played on like a guitar. It has of course but few notes. The performer, however, improves its effect by accompanying it with his voice; and the whole is said to be tolerably agreeable, as the dancers all the while sing tunes, which are not destitute of harmony, and to which they move in exact time.

The Carnicobarians have no notion of a God; or rather their god is the devil, in whose existence they firmly believe, and to whom they pay a most servile worship. They have assigned him the best habitation in the place, in the front of which they have suspended offerings of various kinds. On the approach of a storm, or of any similar calamity, in which they recognise the immediate agency of the evil spirit, they perform many superstitious ceremonies, such as marching round the boundaries of their respective villages, and fixing up at different intervals small sticks split at the top, into which they inserted a piece of cocoa nut, a wisp of tobacco, and the leaf of a certain plant. It is difficult to determine whether these are intended to propitiate the object of their fear, or to frighten him away. It appears, however, that in every village a high pole is erected, with strings of ground-rattans hanging from it, and that, in their opinion, this pole has virtue sufficient to keep him at a distance. Indeed, they seem to place much confidence in charms of this sort; for Lord Valentia tells us, that near the shore he saw a range of small cleft sticks, with a piece of flesh stuck in each, which served as a talisman to keep off death, that had visited them most destructively in the form of the small-pox. In the moral character of the Carnicobarians, there are some respectable qualities, which place them far above many tribes in the same stage of society. In their intercourse with strangers who visit them, they are at first shy and suspicious, probably from the experience or the tradition of some acts of treachery; and this suspicion they shew by appearing every one of them with some weapon in his hand, which he never quits for a moment; but as soon as they see that there is no ground for jealousy, their apprehensions are easily dispelled, and they appear frank and good natured, civil and inoffensive. Their aversion to dishonesty is remarkable. Theft or robbery very seldom occurs among them; is so rare, indeed, that a man when he goes from home never thinks of using the ordinary precautions for securing his property, having no fear of any depredations being committed by his neighbour. Nor is it alleged, so far as we know, that their conduct in this respect is in any degree different in the intercourse and dealings which they have with those strangers, by whom they are frequently visited. It is to be observed, too, that their ideas of property are sufficiently strict; for though they are very willing to impart to one another, yet each has his own personal possessions, consisting of live stock, fishing-lances, hatchets, &c. to which his right is universally acknowledged, and which, if not with the design, at least with the happy effect of preventing disputes among his surviving relations, are all buried in the same grave with himself. They have an uncommon disregard for any thing like ceremony or compliment. When travelling to any distant place, on business or for amusement, they will pass through many villages without speaking to a single person, unless they are charged with some special communication. If tired or hungry, they go into the first house they come to, help themselves freely to what they need, remain till they are refreshed for their journey, and then quietly take their departure, without exchanging a word, or taking the smallest notice of any of the family. They are united, indeed, by a mutual and constant interchange of good offices; and neither feel, nor even show, any of that deference which characterises the more refined stages of civilization. No authority is claimed by one over another, and no peculiar honour is paid to any class of individuals, except to the old, who, merely on account of their age, are treated with a little more respect than others. We are not informed in what light they regard the virtue of chastity. But Mr Hamilton tells us, that polygamy is not known among them; and that they punish adultery with so much severity, as to render that crime of rare occurrence. The punishment consists in cutting off a piece of the foreskin proportioned to the enormity of the offence, or to the frequency with which it has been committed.

The inhabitants of Carnicobar enjoy good health, and meet with few accidents; and their skill in medicine and surgery is not greater than their need of it. Their mode of curing the sting of a scorpion, or centiped, is this: They take the under jaw of a small fish, having two rows of teeth as sharp as needles: these are forcibly struck with a piece of wood, by way of hammer, into the swelling, till it bleed freely, and the diseased part is then bound up with certain leaves till the cure is completed. Mr Hamilton mentions an instance of this mode of treatment which he witnessed, being attended with perfect success in the course of twenty-four hours. When a man dies, all his moveables, as has been already stated, are buried with him; his death is mourned by the whole village, and his wife, according to custom, must either consent to have a joint of one of her fingers amputated, or submit to have a deep notch cut in one of the pillars of her hut. Mr Hamilton gives the following account of the funeral of an old woman, at which he was present. "When we went into the house, which had belonged to the deceased, we found it full of her female relations; some of them were employed in wrapping up the corpse in leaves and cloth, and others tearing in pieces all the cloth which had belonged to her. In another house hard by, the men of the village, with a great many others from the neighbouring towns, were sitting drinking soura and smoking tobacco. In the mean time, two stout young fellows were busy digging a grave in the sand near the house. When the women had done with the corpse, they set up a most hideous howl, upon which the people began to assemble round the grave, and four men went up into the house to bring down the body; in doing this, they were much interrupted by a young man, son to the deceased, who endeavoured with all his might to prevent them, but finding it in vain, he clung round the body, and was carried to the grave along with it; there, after a violent struggle, he was turned away and conducted back to the house. The corpse was now put into the grave, and the lashings which bound the legs and arms cut. All the live stock which had been the property of the deceased, consisting of about half a dozen hogs, and as many fowls, was killed and flung in above it. A man then approached with a bunch of leaves stuck upon the end of a pole, which he swept two or three times gently along the corpse, and then the grave was filled up. During the ceremony the women continued to make the most horrible vocal concert imaginable; the men said nothing. A few days afterwards, a kind of monument was erected over the grave, with a pole upon it, to which long strips of cloth of different colours were hung." Lord Valentia saw, around the village which he visited, tall pieces of bamboo stuck into the ground, each of which, he was told, marked the spot where a person had been interred.

The Carnicobarians carry on some trade. Their cocoanuts are reckoned the finest in that part of India, and there is a regular demand for them from Pegu, and various other quarters. The articles which they require in return are cloth of different colours, hatchets, and hanger blades. These last they use in cutting down the nuts. They usually purchase a greater quantity of cloth than is necessary for their own consumption, which they carry to Chowry, a small island to the southward, and exchange it for canoes, which they cannot make for themselves. For this purpose they send a large fleet of boats every year in the month of November, and these they navigate, not by a compass, of which they know nothing, but by the help of the sun and stars. They are very anxious to procure tobacco and arrack; but these, along with knives, handkerchiefs, and other useful articles, they generally expect to receive in presents. Lord Valentia says, that they required money for the provisions which were obtained from them. To the coin of other countries, however, for they have none of their own, they do not attach any value as a circulating medium. They regard it merely as furnishing them with ornaments, which they esteem beautiful: and this is corroborated by what his lordship adds respecting their preference for dollars; strings of which, Mr Hamilton informs us, are worn by the young women about their necks. They are said to be good judges of silver and gold, which they very readily distinguish from the baser metals that are sometimes, in the course of trade, attempted to be substituted in their place. See Mr Hamilton's *Short Description of Carnicobar*, in the *Asiatic Researches*, vol. ii. p. 337, *et seq*. Lord Valentia's *Voyages and Travels*, p. 53, which is accompanied with a view by Mr Salt of one side of the island of Carnicobar. Mr Dalrymple, in his *Oriental Repertory*, vol. i. p. 104, mentions, that, in 1687, Captain Weldon surveyed the Nicobars; "which survey," he adds, "with the history of them by a Spanish priest, who had resided there many years, was sent to the company, and may possibly be still extant." (τ)

CARNIOLA, a duchy of Germany, in the circle of Austria: bounded towards the north by Carinthia and Styria; on the west by Friuli, the country of Gorz, and the Adriatic Sea; on the south by the same sea, and the part of Istria possessed by the republic of Venice; and on the east by Dalmatia and Croatia. This province is situated in latitude between 44° 48′ and 46° 7′ north, in longitude between 13° 33′ and 15° 40′ east. Its greatest length, from west to east, is about 120 miles. Its greatest breadth is about 100. The face of this country is for the most part mountainous. Some of its mountains are more or less cultivated and inhabited, others are altogether in a desert state: Some of them are naked, others clothed with wood. The summits of several of them, especially in Upper Carniola, are continually covered with snow. One of the loftiest mountains in the Austrian dominions occurs in this quarter, namely the Terklou, which rises to the height of 10,194 feet above the level of the sea. This is the principal summit in the southern chain of the Alps, which traverse this duchy in a direction from west to east; and which, to the westward of this central or dividing point, are known by the name of the Carnatic Alps; to the east of it by that of the Julian. Other considerable mountains in these parts are the Caleberg; the Lobel, which separates Carniola from Carinthia, and affords from its summit a very fine prospect; the Rum-berg, the Karst, and the Nanas. Among these mountains are interspersed many fruitful vallies and fields, which form an agreeable variety, and are of the greatest consequence to the subsistence and comfort of the inhabitants. The declination of the duchy of Carinthia, as well as generally of the immediately adjoining provinces, is for the most part from west to east. This is evinced by the circumstance, that the rivers in these parts chiefly run in that direction. The same thing is evident from the aspect of the mountains, which obviously decrease in elevation as they are situated more to the eastward. Thus, in the line of the Alps before mentioned, the summits, after the Terklou is passed, decline much in height, and no longer exhibit any thing but the appearance of calcareous rocks, curiously chapped and hollowed out; in some places rising into steep and inaccessible points; in others sinking down into deep caverns, or pierced, in a horizontal direction, into far extending grottos.

The aspect of this country externally, is altogether such as should give reason to expect an abundant supply of valuable mineral substances. Here accordingly are mines of iron, lead, and copper. Quicksilver also and cinnabar are found in great quantity. The most ancient and the most noted of the mines from which the iron is drawn, is situated in the mountain of Eisenberg, or Naseleiro. At Ainem, or Selelniko, there is also an excellent iron mine, and one at Janerbourg, which is of importance by furnishing materials for the manufacture of steel in this country. There are not in Carniola any mines of gold or silver; but those which it has are perhaps hardly less profitable to it. The quicksilver mines in Idria are of great celebrity, and equally valuable. They are the richest of this description in Europe, yielding annually to the amount of 12,000 quintals of pure quicksilver, besides about 6000 or 7000 quintals of native cinnabar. The Spaniards have been accustomed to purchase the half of the mercury procured here, at the rate of two piastres per quintal. These mines were accidentally discovered in 1497. They have been hollowed out to the depth of about 900 feet, and the mercury is obtained from the numerous subterranean cavities that have been opened in them in great abundance, being found in stones, in a sort of clay, and sometimes in a disengaged state, issuing from the rocks, and dropping spontaneously on the ground below. There are here various other sorts of mineral produce, some of greater, others of less consideration. The Carniola marble is reckoned beautiful, and it is found in great abundance and variety in different parts of the country. There is found here also alum, nitre, vitriol, bolar earth, and fullers' earth. Rock crystals are frequent, likewise beautiful hyacinths, eagle-stones, and blood-stones.

The vegetable productions of Carniola are of the same kinds that prevail generally in the surrounding district of country. Wheat, barley, rye, various leguminous crops, and others which contribute most directly and essentially to the support of human life, are raised here in considerable quantity and perfection. Millet also is a usual crop, as is buckwheat, especially in the sandy plains. Various and excellent fruits are produced in this country, such as pears and apples, oranges, citrons, pomegranates, almonds, figs, chesnuts, walnuts, olives, and lemons. Carniola does not yield a great deal of wine; but what it has, both white and red, is of a superior quality. A great deal of cider is prepared in the province; and, with a view to this, much attention is paid to the propagation and the management of the apple trees; indeed, the fruit trees in general are well attended to, and in this department a great number of the inhabitants find employment. Flax is raised here, and a little hemp. The flax is esteemed to be particularly good. Artificial meadows are frequent, from which fodder is procured for the maintenance of domestic animals. The ground in this province that is capable of bearing cultivated crops is generally fertile, and, from the management that is adopted, is often made to yield two harvests in the year; buckwheat being commonly sown after the removal from the fields of the other descriptions of grain, and millet in the places which had been previously occupied with flax or hemp. Truffles, and a variety of medicinal plants, occur in this district; and, in general, many parts of the mountains, by which so much of the whole surface is occupied, present, even in the midst of arid rocks, a brilliant vegetation, which, joined to the imposing aspect of the extended lakes and rapid rivers in the vicinity, forms the most picturesque views, and recals to the recollection some of the noted scenes of Switzerland.

There is found in Carniola an abundance of good pasturage, by means of which there are maintained numerous herds of a tolerably good, though not the largest breed of cattle. The number of horned animals stated to be in the country in the year 1780, was 44,098. The number of horses, at the same period, is estimated at 16,232. A very fine race of horses is not to be expected in mountainous districts like this; yet, on the mountain of Karst, in this duchy, and in the valley of Geil, in Carinthia, more attention, it may be observed, is paid to the horses, than is usually given in other contiguous parts; and the horses of Carniola, though generally only of a middle size, are yet known to be strong, and very sure footed, and consequently well adapted for carrying burdens over those mountainous grounds. Asses and mules, which are in this respect so well calculated to be useful in such districts, and may therefore commonly be expected in them, are here pretty numerous. There are also considerable flocks of sheep, which have been noted for the delicacy and tenderness of their flesh. The rams are without horns; and the fleeces which are borne by the breed of sheep in this duchy, are not inferior in quality to those of Padona. Game and poultry abound here, as also fish. Numerous bees are reared; likewise silk worms: both which classes of industrious insects, from the returns which they have yielded, have been found objects well deserving the care of those who have directed to them their attention.

The principal rivers of Carniola are the Save, the Laybach, the Gurk, and the Culpa. Of these, the most considerable is the Save, which takes its rise in Upper Carniola, near to the village of Ratschach, and in its course receives the waters of all the other rivers that have been mentioned. This river, though it flows very rapidly, is yet navigable; it discharges itself into the Danube at Belgrade, in Servia. The chief lakes of the duchy are the Feldesser, the Wochein, and the Zirknitz Sea. Both the rivers and the lakes generally abound with fish.

The duchy of Carniola is subdivided into several inferior districts. These are the Upper, Lower, Middle, and Inner Carniolas, and the Austrian Istria. Certain lines of distinction have been traced, by which it has been considered, that those divisions of this territory might appropriately be marked out, and separated from one another. These distinctions are not, however, in every case very clear, or very significant; and, indeed, any thing of importance relative to this matter might be comprised within very narrow limits. With respect to Upper Carniola, it is observed, that the air of that district is pure and wholesome,—that there is every where found in it an abundance of good spring-water,—and that this division of the country raises commonly a sufficient supply of corn for the support of its inhabitants. Vines succeed here, but they are not found in great quantity. The more usually cultivated crops are raised with ease, and yield an early and abundant return. Yet the district is mountainous, and the air on the upper grounds so chill, that the inhabitants are exposed to degrees of cold not inferior to those that are experienced in the higher parts of Scotland. Lower Carniola contains many fruitful vallies and tracts, and yields an excellent wine called Marchevin. Middle Carniola is mountainous, and more noted for the number of its villages, which seem to imply an abundant population, than for the production of the crops that might appear necessary for their subsistence. Inner Carniola is also mountainous, and yields little corn. Both of these districts, however, produce considerable quantities of wine; and the latter is noted for its breed of horses, which find a ready market in Austria and Italy. Istria is very fertile in wine, oil, corn, and other articles of subsistence. Indeed, in the southern parts of Carniola in general, the olive, rice, and other productions peculiar to the warm climates, succeed perfectly, and arrive at maturity. But it is a material drawback upon the greater part of this whole province, that water is extremely scarce in it, or of very bad quality.

The capital of Carniola is Laybach. This is a handsome town, containing a great number of elegant structures, and amongst these several public buildings. Some of its churches, especially in the interior, are in a far better taste than is usually found in Germany. The river of the same name runs through the town; but, though navigable, is not turned to any very considerable account. Trieste is more a seat of trade. Indeed, this is what may be called the main rendezvous of the Austrian marine. Here there is a harbour, at once secure and commodious, which is frequented by a great deal of shipping. The number of vessels that depart from, or come into this port annually, is reckoned to be from 5000 to 6000; and the value of the merchandise exported or imported is estimated at from fourteen to fifteen millions of florins. It is chiefly by way of this port that the trade between the different states of the empire and the Levant, or other maritime parts, is conducted, the necessary communication for that purpose with the interior being maintained, either by the public roads, which are here generally good, or by the navigable rivers. Trieste, as a town, contains a great number of well built houses of stone: the streets are wide, and paved with very large flag-stones. The thriving state of the place is evinced by the face of activity which every where appears, and by the rapidly increasing population.

In the duchy of Carniola, in general, the spirit of industry and exertion in the departments of manufactures and commerce is by no means dormant; and if the state of society, or the progress of improvement, seem hardly to be adequate to what might have been expected, from a consideration of the natural riches and advantages which this province enjoys, its situation in these respects is yet far from being wretched or contemptible. One great source of the industry of Carniola is furnished by its mines. There are here several considerable iron manufactories. There is one wire-drawing mill, three forges for steel, and six for nails; in which last there are made annually from 8000 to 10,000 quintals of nails, in value from 150,000 to 200,000 florins. There are in Carniola, besides, two great glass-works; in one of which a sort of Tuscan vessels are made, resembling in their appearance delft or Dutch ware. There is here, also, a manufactory of pipes. Carniola has a woollen manufacture. A great deal of cloth is prepared at Laybach, and woollen hosiery is manufactured in considerable quantity at Weichselburgh, at Strachina, and at Newmarktl. A spinning-work has likewise been established, a lace manufactory, and a manufactory of linen. The most esteemed linen, procured from this quarter, is made at Bischoflack, in the environs of Laybach, and at Dobronina. There are several bleaching fields here.

The number of looms in the province is estimated at 800; and the value of all the cloth annually made in it has been rated at 600,000 florins.

The exports from this province are chiefly iron, steel, mercury, wines, olive-oil, olives, chesnuts, and various other fruits, horses, cattle, linen, woollen stuffs, cheese, leather, honey, ship-timber, with all sorts of little works in wood, such as boxes, dishes, spoons, &c. One of the most material articles of import is corn, of which the native soil does not in ordinary years raise enough to answer to the consumption of the inhabitants. This province is also without the fossil salt or salt-springs, which, found in other situations, are reckoned among the treasures of Austria. Whatever salt therefore is required, in addition to the quantity of sea-salt manufactured in the province,* must be obtained from the sovereign's magazines.

Some idea of the relative importance of this duchy may perhaps be formed, from a consideration of the amount of its contributions at different periods for the support of government. This province, according to Busching, advanced for that purpose in 1770, 2,089,952 florins. In 1780, according to Schlæzer, its contribution was 1,650,000 florins. It contributed in 1803, according to the manual of Frankfort, 1,300,000 florins; according to Ockhart, 2,100,000. That its mines, generally taken, are not of the most considerable order, may reasonably be inferred from the circumstance, that it is not rated as contributing any thing to the montanisticum, or the revenue accruing to the emperor from the produce of all the mines. Its wealth in this department has, however, been of not a little importance towards the enlargement of the public revenues. The quicksilver mines of Idria yield annually to the emperor nearly 1,000,000 of florins.

Carniola possesses a robust and hardy peasantry. With the common people of this country, it is usual to go barefooted in winter through the snow with open breasts, and to sleep on a hard bench without bed or bolster. The food of this order of people is very coarse and mean. In winter, when the snow lies deep on the ground, the mountaineers, in the manner of the Laplanders, bind either small baskets, or long thin narrow boards, to their feet, on which, with the help of a stout staff, they descend with great velocity from the mountains. When the snow is frozen, they make use of a sort of skaits for the same purpose.

In this duchy there occur numerous natural curiosities. The vast grottos with which Carniola so much abounds, are such, that nothing similar to them is found in Europe. The principal tract of the grottos is in what is called the Pear-tree Wood, which is one of the most considerable forests in the empire, but marked throughout by a face of the most inhospitable desolation. Some of these grottos, or subterraneous caverns, are said to be upwards of four miles in length. They rise also, in some instances, one tier above another; every several grotto extending in breadth and height from 12, perhaps to 20 feet, and exhibiting in the interior a great variety of stalactites of singular form and appearance. The most noted of these grottos are the Magdalen grotto near Adelsberg, that of Lueg, that of St Servio near Trieste, the grotto of Corgnale, and those of the lake of Zirknitz. Amongst these, the grotto of Corgnale is particularly striking, both in respect of the magnificence and the variety of its stalactites, and the length and massiness of the columns on which the vaulted roof seems to repose. Zirknitz is not more remarkable on account of the grottos in that quarter, than for other natural phenomena of a very singular kind, by which it is distinguished. This place has indeed many attractions. The mountains, the rocks, the woods, the smiling plains, the fertile fields, and the villages scattered here and there, which, in various directions, bound this fine sheet of water, or offer themselves to the eye in striking contrast or connection with it, or with one another, form a scene highly picturesque and agreeable. The prospect is farther enriched and animated, by the beautiful and well cultivated islands which rise from the bosom of the lake, and by the restless activity of several rivulets, which, in different quarters, hasten to convey to it the tribute of their streams. The usual egress of the waters of this lake, is by two openings which nature has formed for them through one of the adjoining rocks. But besides these two cavities, by means of which the lake is prevented from rising above a certain level, there are several others in the bottom of it, (and this is what has been most noted in these parts,) through the effect of which it every now and then disappears entirely. When this event is about to take place, the waters crowd in succession about the different openings, and in the vicinity of them respectively the bottom is after a time laid bare, till after the lapse of about 25 days no vestige of the lake any longer remains. The period when the water is about to depart is that when fishing is permitted in the lake, and at those seasons accordingly, there is procured an abundant supply of large fishes, chiefly pikes. After the waters are gone, a field is presented, in the channel that they had occupied, very proper for cultivation, which it is immediately begun to labour and to sow. An abundant vegetation soon covers the place. Three months afterwards the peasants collect from it crops of hay and millet, and game is pursued in situations where so short a time before there had been no other living creature but fishes. There is no precise time for these departures of the lake. It has been known sometimes to disappear and to return thrice in the course of a year, and some years it has not disappeared at all. Its return, however, uniformly takes place after a space of not more than four months. Then the water is seen for a short time rising with vigour through the different openings, and, within 24 hours, the basin is completely filled as before its departure. This singular phenomenon has naturally attracted a good deal of attention; and superstition, as usually happens, has busied itself in converting it into a source of alarm and terror. It may, however, without difficulty, be accounted for upon natural principles. The Carniolian Alps in general, as that vast chain of mountains is called which traverses this country from Dalmatia to Carinthia, may in fact be considered as one great mass of calcareous matter, which hollowed into a great number of grottos and extensive cavities, affords opportunity for the accumulation in particular places of great quantities of snow or rain water. With reservoirs of this kind, there is every probability that the principal cavities in the bottom of the lake of Zirknitz communicate; whence it is, that when the water in these receptacles is from any cause considerably lowered, the water of this lake falls down to fill up the vacuity; but when, from other contiguous subterraneous lakes, or in any way else, more water is brought into them than they are capable of containing, then a quantity of it is forced up through the cavities mentioned, and thus the lake of Zirknitz is replaced in its original condition. In connection with these natural curiosities, there may be noticed here a remarkable work of art. This is the road known by the name of the pass of Lobel, by which a communication is formed between this duchy and that of Carinthia, and which, in respect of the length that it has been carried over a very elevated tract of ground, is certainly not equalled by any thing to be found in Europe.

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* Carniola prepares of sea salt, annually, from 30,000 to 40,000 metzen or minots of Vienna. This is a measure of 3.100 cubic inches.

Carniola was known so early as the 8th century, by the same name which it still bears. Its more ancient name appears to have been Crania. It was at the period alluded to, that the Christian religion was introduced into the country. It was endeavoured, in the 16th century, to communicate to the inhabitants the benefits of the Reformation. The success, however, appears not to have been considerable, as even at present the prevailing system in that quarter is the Roman Catholic. A few Walachians, or Uskokes, who have their residence here, are of the Greek church.

There is a material difference observable between the different parts of this country, in respect of manners, dress, and language. In Upper and Lower Carniola long beards are worn. There are two distinct languages spoken in the country, the Sclavonian, to wit, or Wendish, and the German, corresponding, it may be observed, to the diversity, in point of origin, by which this people are distinguished, of whom the commonalty, it is understood, are chiefly of Sclavonic extraction, the nobility of German. The Slaves, or Wends, are said to have taken possession of this country after the year 548. In the time of Charlemagne and his posterity, it was governed by the dukes of Friuli, and afterwards by those of Carinthia. Under Otto II. it became a distinct margraviate. It finally was vested in the House of Austria; and from a marquisate, which it had long been, it was, in 1231, raised to the rank of a duchy. It participated with other provinces in the effect of the division of the Austrian States, from 1395 to 1496. Otherwise, it has, with little interruption, ever since its first accession to them, continued to form a part of the Austrian dominions. Towards the maintenance of the military power of that state, it contributes annually 363,171 florins. The forces usually quartered in it, are only two regiments of foot.

The following particulars, relative to this duchy, are extracted from a statistical account of the Austrian monarchy, published by Messrs Raymond and Roth, 1809:

The population, in 1783, of the circle of Laybach, 133,239; of Neustadt, 145,479; of Adelsberg, 133,085; and of the whole duchy, 433,000. Number of marriages, in 1791, including Friuli and Trieste, 5533; of births, 23,723; and of deaths, 17,930,

Dwellings.	1783.	1801.
Cities	19	19
Market-towns	18	18
Villages	3,302	3,312
Houses	69,850	74,654
Ecclesiastics		858
Nobles		328
In employs		745
Citizens		2,817
Peasants		50,617
Males		199,368
Females		209,686
Families		75,333
Wendes		360,000
Germans		28,000
Convents		7
Castles		200
Parishes		134

The principal towns in Carniola, are Laybach, which, in 1798, contained 1300 houses, and 20,000 inhabitants; and Ydria, which contained 312 houses, and 3500 inhabitants. See *Tableau Statist. de la Monarchie Autrich. &c.* par Raymond and Roth; *Annales des Voyages, de la Geogr. et de l'Hist. Publices*, par M. Malte. Brun; *Dictionnaire Universel de la Geogr. Commerçante*, par J. Peuchet; and Kuttner's *Travels*. (E)

CAROLAN, Twalogh, a celebrated poet and musical composer, justly stiled the *Irish Handel*, was born in the year 1670, in the village of Nabber, in the county of Westmeath, on the lands of Carolan's town, which formerly belonged to his ancestors. It is greatly to be regretted, that so little is known of the early part of the life of this eccentric and surprising genius. His father was only a poor farmer, the proprietor of a few acres, which yielded him a scanty subsistence. The cabin in which our bard was born, is still pointed out to the inquiring traveller. It is now in a ruinous state, and must soon become a prey to all-devouring time; yet the spot where it stood will perhaps be visited at a future day, by the lovers of national music and song, with as much true devotion, as the birth-place of Shakespeare, or the cottage of Burns. The small-pox deprived him of his eyesight at so early a period, that he retained no recollection of colours; yet, from this misfortune, he felt no uneasiness, and was never heard to complain. "My eyes," he used to say, "are transplanted to my ears." It was early discovered, that young Carolan had a genius for music, and his friends determined to cultivate it by every means in their power. When about ten years of age, a proper person was engaged to instruct him in the practice of the harp; but, though fond of that instrument, he never struck it with a master's hand. It has been justly remarked, that genius and diligence are seldom united; and yet it is to practice alone, that we owe perfection in any art. His harp, however, was rarely unstrung; but, in general, he used it only to assist him in composition; his fingers wandered through the strings in quest of melody, while his mind was only intent on the musical expression of the then vibrating chord. At an early period, our bard became enamoured of a Miss Cruise, of Cruise Town, county of Longford: his harp now, like the lute of Anacreon, would sound only to love. His passion for this lady almost exceeds belief; yet she never gave him her hand, though it cannot be doubted, that he held at one time the first place in her breast. The song which bears her name is his master-piece; it came warm from his heart, while his genius was in full vigour, and inspired by her whom his soul adored. A very extraordinary instance of the effect of Carolan's passion for this lady is related by one of his biographers: He went once on a pilgrimage to St Patrick's Purgatory, a cave in the island of Lough Dearg, county of Donegall. On his return to the shore, he met several pilgrims waiting the arrival of the boat that conveyed him. In assisting some of these to get on board, he chanced to take a lady's hand, and instantly exclaimed—"By the head of my gossip, this is the hand of Bridget Cruise!" His sense of feeling had not deceived him; it was the hand of her whom he had once adored. This anecdote is certainly curious, and cannot fail to convey a strong impression of the emotions which he felt, on meeting the object of his early affections. Carolan had been at this time many years married, and was in the middle of his earthly career. Our bard having at length discovered, that it would be impossible for him to gain the consent of Miss Cruise, made application elsewhere; and after a long and tedious courtship, obtained the hand of Mary M'Guire, a young lady of good family, in the county of Fermanagh; and shortly after fixed his residence on a small farm near Mosshill, in the county of Leitrim. Here he built a neat cottage, where he lived for a while comfortably, and gave every friend that called a kind and hearty welcome. His ardent hospitality, however, soon consumed the produce of his little farm; he ate, drank, and was merry, and imprudently left to-morrow to provide for itself. This mode of life soon occasioned embarrassments in his domestic affairs; but, like too many others on whom nature has bestowed strong powers of mind, he forgot to reflect in due time, that nothing can supply the want of prudence; and that negligence and irregularity long continued, will render even genius itself contemptible. Carolan, finding he could not support his family in this way, resolved to become an itinerant harper and bard, (see Bard,) in which character he continued during the remainder of his life; travelling through the country, mounted on a good horse, attended by a domestic on another, who carried his harp. Wherever he went, the gates of the nobility and gentry were thrown open to him; he was received with respect, and a distinguished place assigned him at table. At the house of the late Colonel Archdall he always met the most flattering attention; and he never mentioned this gentleman, but with the most profound respect.

At Moneyglass, near Toom, in the county of Antrim, the hospitable mansion of the late Mr Jones, he spent many a pleasant day; nor was he deficient in gratitude for the many civilities he experienced during his stay. He has enshrined the convivial and philanthropic character of Mr Jones, in one of his best *planxties*; of this, the air alone remains, the words are now forgotten. The well-known English version, called "Bumper Squire Jones," being written by Baron Dawson, and is one of the best drinking songs extant, and well adapted to the original air of Carolan. It was during his peregrinations, that Carolan composed all those airs which are still the delight of his countrymen, and will transmit his name to the remotest posterity. He thought the tribute of a song due to every house in which he was entertained, and he never failed to pay it; generally choosing for his subject the head of the family, or the loveliest of its branches. The subject of one of his favourite and most admired compositions was a Miss Nugent, who lived near Belanagar, in the county of Roscommon, when she inspired our bard; and he has endeavoured to do justice to her merits in the song now well known by the name of *Gracy Nugent*. A *Miss Fetherston*, of the county of Longford, whom he accidentally met on her way to church, gave rise to the much admired composition called "Carolan's Devotion." It is related, on good authority, that Carolan in his gayest mood, and even when his genius was most inspired by the flowing bowl, could never compose a planxty on a Miss Brett, in the county of Sligo, whose father's house he frequented, and where he always met a reception due to his taste and endowments. One day, it is said, after an unsuccessful attempt to compose something in a sprightly strain on this amiable young lady, he threw aside his harp in a mixture of rage and grief, and addressing himself in Irish to her mother, "Madam," said he, "I have often, from my great respect to your family, attempted a planxty, in order to celebrate your daughter's perfections, but to no purpose. Some evil genius always hovers over me—there is not a string in my harp that does not vibrate a melancholy sound whenever I set about this task. I fear she is not doomed to remain long amongst us." Tradition says, that the event verified the melancholy prediction, as the young lady did not survive it twelve months. Carolan, from a defect in education, had in his early days contracted a fondness for spirituous liquors, which never forsook him during the remainder of his life; but inordinate gratifications always carry their punishment along with them; nor was Carolan exempt from suffering his full share. His physicians having assured him, that unless he corrected this pernicious habit, a scurvy, which was the consequence of his intemperance, would soon put an end to his mortal career; he at last, though with great reluctance, promised to obey, and seriously resolved upon never again tasting the seducing cup. The town of Boyle was at this time his principal place of residence. There, whilst under this severe regimen, he wandered about the streets; his usual gaiety forsook him; no sallies of his once lively imagination broke out; every moment was laden with care, and marked with a dejection of spirits bordering on the deepest melancholy; his favourite harp lay in an obscure corner of his habitation, neglected and unstrung. In this deplorable situation, passing a whisky shop one day in town, after having abstained six weeks from tasting spirits, he was tempted to step in, undetermined whether to yield to the temptation, or adhere to his late resolutions. "Well, my dear friend," said he to the young man who stood behind the counter, "you see I am a man of constancy; for these *six long weeks* I have refrained from *whisky*—was ever there so great an instance of self-denial? But a thought strikes me—you will surely not deny me the favour I am about to solicit. Bring me a measure of my favourite liquor, that I may just smell it, and I assure you I will not put it within my lips." The young man complied with his request, and no sooner did the fumes ascend into his brain, than every latent spark within him was rekindled, his countenance glowed with unusual brightness, and he poured forth the effusions of a heart newly animated, in wild but poetic expressions over the bowl to which he owed his inspiration. At length, to the great peril of his health, and contrary to the advice of all his friends, he once more drank the prohibited beverage, renewing the draught until his spirits had fully resumed their former tone. He then immediately set about composing the much admired and far famed song, which goes by the name of "Carolan's Receipt for drinking Whisky." He commenced the words, and began to modulate the air that evening in Boyle; and, before ten o'clock the next morning, he sung and played this noble offspring of his imagination in Mr Stafford's parlour at Elphin. In justice, however, to Carolan, it must be remarked, that notwithstanding his fondness for spirituous liquors, he very seldom carried his drinking the length of intoxication; but he imagined that whisky assisted him in his musical composition, and therefore never composed without a bottle of it beside him. To deny Carolan his favourite beverage, was a certain method of rousing his satire. Being one time in the house of an old lady, who was remarkably parsimonious in this way, he chanced to hear the butler, whose name was O'Flinn, open the cellar door, and laying aside his harp, followed him into the cellar, requesting a cup of beer; the butler, in rather an insulting tone, ordered him out, declaring he would give him nothing without orders.

Carolan indignantly exclaimed,

> "What a pity Hell's gates were not kept by O'Flinn.
> So surly a dog would let nobody in!"

The fame of Carolan, as a musician, having reached the ears of an eminent Italian music-master in Dublin, he determined to put his abilities to a severe trial, the result of which convinced him how well-founded had been whatever was said in his favour. The method he made use of was this: he selected an excellent piece of music in the Italian style; but here and there either altered or mutilated it in such a way, that none but a real judge could detect the alterations. Carolan bestowed the deepest attention on the performer, while he was playing it, not knowing it was intended as a trial of his skill, and that the critical moment was at hand which was to determine his reputation, as a musician, for ever. He declared it to be an excellent piece of music, but to the astonishment of all present, he said, very humorously, in his own language, *Ia se air chois air bacaighe*, that is, literally, "Here and there it limps and stumbles." He was then requested to rectify the errors, which he accordingly did; and in this state, the piece was sent from Connaught to Dublin. The Italian no sooner saw it, than he pronounced Carolan to be a true musical genius.

In 1733, Carolan experienced a severe domestic affliction in the death of his wife, which had a visible effect on his constitution. His spirits greatly forsook him, and the only piece of composition that he attempted from that to his death, was a monody on her death, known by the name of "Mary M'Guire." Carolan, while on a visit at Mrs M'Dermott's of Alderford, in the county of Roscommon, was taken suddenly ill, and died there in the month of March 1738, in the 68th year of his age; and was interred in the parish church of Kilronan, in the diocese of Ardagh. But no memorial exists of the spot in which his remains were laid. He had seven children by his wife, six daughters, and one son, who studied music, and went to London, where he taught the Irish harp. Before his departure, he published, in 1747, a collection of his father's music; but omitted, through mercenary motives, some of the very best of his pieces. It was republished in Dublin, by John Lee, in 1780.

Carolan, as a musician, stands in the very first class, and has added considerably to the ancient stock of Irish music, for which his country has been, from the earliest times, so celebrated. Many of his pieces, it is to be feared, are now lost; but we hope, that most of them may yet be recovered, through the indefatigable exertions of the ingenious Mr Bunting of Belfast. See his *General collection of the Ancient Music of Ireland*; and the *Belfast Monthly Magazine*, No. 12, vol. iii. (c)

CAROLINA, NORTH, one of the United States of America, is bounded on the north by Virginia, on the east by the Atlantic Ocean, on the south by South Carolina and Georgia, and on the west by the state of Tennessee. According to its charter limits, however, it extends much farther on the west, including the state of Tennessee, as far as the river Mississippi. By the treaty of 1763, Great Britain gave up her claim to all territory westward of the Mississippi; and the courts of France and Spain, at the same time, granted her the free navigation of that river. At the termination of the American war, Great Britain transferred her interest in that river to the United States. But since Spain, forgetting the treaty of 1763, now claims the exclusive right of navigating the Mississippi, North Carolina resumes her claims to the lands beyond it, included within the limits of her original charter. By that charter, it extended 758 miles in length, and 110 in breadth, between 34° and 36° of north latitude, and 76° and 92° of west longitude. As these boundaries, however, are disputed by the Spaniards and Carolinians, it is safer to adhere, in a geographical description, to the limits which are generally recognised. Exclusive of the state of Tennessee, North Carolina is situated between 35° 50′ and 36° 30′ north latitude, and between 76° 8′ and 83° 8′ west longitude, being about 450 miles in length, and 180 in its greatest breadth, and containing about 34,000 square miles. Its districts, eight in number, are classed in three divisions: The *eastern* districts, Edenton, Newbern, and Wilmington; the *middle* districts, Fayette, Hillsborough, and Halifax; and the *western* districts, Morgan and Salisbury. The eastern districts stretch along the sea coast, from the Virginian line to South Carolina; the other five include the whole state west of the maritime districts, and the greater part of them extend across the state, from north to south. These districts are subdivided into fifty-eight counties, in the following order: In Edenton are the counties of Chowan, Churrituck, Cambden, Pasquotank, Penquimins, Gates, Hertford, Bertie, and Tyrrel; in Wilmington are the counties of New Hanover, Brunswick, Onslow, Duplin, Bladen; in Newbern, the counties of Craven, Beaufort, Carteret, Pitt, Hyde, Jones, Wayne, Glasgow, Lenoir, Johnston; in Halifax, the counties of Northampton, Halifax, Martin, Edgecomb, Warren, Franklin, Nash; in Fayette, the counties of Moore, Cumberland, Sampson, Richmond, Robeson, and Anson; in Hillsborough, the counties of Granville, Pearson, Caswell, Orange, Wake, Chatham, and Randolph; in Morgan, the counties of Burke, Wilkes, Rutherford, Lincoln, and Buncomb; in Salisbury are the counties of Rockingham, Guilford, Montgomery, Stokes, Surry, Iredell, Rowan, Cabarrus, and Mecklenburg.

The general aspect of North Carolina is by no means interesting. In its whole width, for about sixty miles from the sea, it is a dead level, varied only by occasional openings in the immense forest with which it is covered. After traversing this tedious plain, we are at length relieved by the appearance of hills and mountains; from the summits of which we behold a beautiful country, stretching west far beyond the range of vision, watered by the broad stream of the Tennessee, and adorned with forests of lofty trees. The general aspect of this state, which in all its features, resembles that of SOUTH CAROLINA, will be found more minutely described under that article.

In the level part of North Carolina, the soil is but indifferent. On the banks of some of the rivers, however, and particularly of the Roanoke, it is remarkably fertile. Even in the other parts of this champaign country, glades of rich swamp, and ridges of oak-land, of a black and fruitful soil, form an exception to its general sterility. The whole of this level tract abounds with marine productions, which are found by digging a few feet below the surface. The sea coast, the sounds, inlets, and lower parts of the rivers, have invariably a soft muddy bottom. That part of the state which lies west of the mountains, extending in length about 300 miles, and upwards of 100 in breadth, is, with a few partial exceptions, remarkably fertile, and abounds with oak trees of various kinds, walnut, elm, linn, and cherry trees; the last of which grows here to such a size, that many of them are three feet in diameter. In the hilly country, the soil and productions are nearly the same as in the northern states. Wheat, rye, barley, oats, and flax, are the crops most generally cultivated, and seem to suit well the nature of the soil. Throughout the whole of North Carolina, Indian corn and pulse of all kinds are reared with success. Here is a species of pulse, pretty common in this country, called ground peas, which run on the surface of the ground. To bring them to perfection, they are covered with a light mound, and the pods grow under ground. They may be eaten either raw or roasted, and in taste resemble a hazel-nut. Cotton is planted in considerable quantities, though the culture of this plant might still be greatly increased. As the stalk is killed by the frost, it is necessary to plant it yearly.

The indigenous productions of this country are not unworthy the attention of the botanist and natural historian. Of the plains in the low country, the large natural growth is almost universally pitch-pine, a tall and beautiful tree, which grows here to a size far superior to the pitch-pine of the northern states. This valuable tree affords pitch, tar, turpentine, and various kinds of lumber, which, together, constitute at least one-half of the exports of North Carolina. It is of two kinds, the common, and the long-leaved. The latter differs from other pines, not in the shape, but in the length of its leaves, which are nearly half a yard long, and hang in large clusters. This country produces white and red oak of the finest quality, and its swamps abound with cypress and bay trees. Oak, walnut, and pine, are the most common species of timber in the back country. In the moist gravelly soil, there grows a kind of stunted oak, called by the inhabitants black jack, which seldom exceeds eight or nine inches in diameter. The trees in the low country, near the sea-coast, are loaded with quantities of a long spongy moss, which, by absorbing the noxious vapour exhaled from stagnated waters, is supposed to contribute much to the healthiness of the climate. The hypothesis is supported by experience; for it is generally observed that the country, after being cleared, is less healthful than before. The misletoe frequently engrafts itself upon the trees in the back country. Plums, grapes, strawberries, and blackberries, grow spontaneously in this happy soil. Besides being covered with herbage of various kinds, and with a species of wild-grass, it abounds with medicinal plants and roots; the most valuable of which are the ginseng, Virginia snake-root, Seneca snake-root, an herb of emetic quality resembling ipecacuanha, and lion's heart, a sovereign remedy for the bite of a serpent. In many places there is found a sensitive briar, which, on the slightest touch of a leaf, turns, and clings close to its stalk, and in about two minutes after, perfectly recovers its former situation. The stalk of this plant dies in winter, but its root survives, and shoots forth a new stalk in spring. To this list of indigenous plants and herbs, we may add the Muscipula veneris. The rich bottoms are overgrown with canes, the leaves of which continue green all winter, and afford excellent pasture for cattle.

Of all the United States, North Carolina seems to be farthest removed from that perfection of culture, which is necessary to give it the full advantage of the natural richness of its soil, and the value of its productions. One great cause of its backwardness in agricultural improvements, is the want of inland navigation, and of proper harbours. The first impediment arises not so much from the smallness or shallowness of the rivers, as from the bars of hard sand which block up their mouths.

The Chowan river, formed by the confluence of three streams which rise in Virginia, is three miles wide where it falls into Albemarle Sound, but narrows very rapidly in its ascent. The Roanoke, though a river of great length, is so extremely rapid, and so full of water-falls, that it can be navigated only by shallops, nor by these more than sixty or seventy miles from its discharge into Albemarle Sound. The Pamlico, or Tar river, flowing into Pamlico Sound, is navigable for vessels drawing nine feet of water, as far as the town of Washington, about forty miles from the coast; and for scows or flats to the town of Tarborough, fifty miles farther up. The Neus river, falling likewise into Pamlico Sound, is navigable for ships of considerable burden, about twelve miles above the town of Newbern, for scows fifty miles, and for boats two hundred miles. Besides these, there are many smaller rivers, all of which are navigable so long as they continue broad enough for a vessel to turn. The Tennessee, too, rolls part of its majestic stream through this state, and receives in its course several tributary waters. In bursting through the Cumberland or Laurel Mountains, it occasions a remarkable whirlpool. From an expanse of half a mile, it is here confined to the width of about 100 yards. Just as it enters the mountain, a large rock, projecting obliquely from the northern shore, renders the channel of the river still narrower, and causes a sudden bend. The water, thrown with great force against the southern shore, rebounds around the point of the rock, and produces the whirl, which is about eighty yards in circumference. In less than a mile below this whirl, the river expands into its usual breadth, and continues to flow in placid beauty, till it mingles with the Ohio. These rivers, if accessible to ships of any magnitude, would greatly facilitate the internal commerce of North Carolina; but they are unfortunately rendered almost useless in that respect by the sand bars at their entrance.

Nor is this inconvenience compensated by any fine harbours, spacious bays, or bold inroads of the ocean into the country. It has, indeed, some extensive sounds, such as Pamlico, Albemarle, and Core sounds; but these may be regarded as mere lakes, for the inlets by which they are connected with the ocean are so small, as to be navigable only to boats or small vessels, and admit so little of the tide, that the rivers which flow into the sounds receive not, even at their mouths, the slightest taste of brine. This state cannot boast of one good harbour throughout the whole extent of its coast. It is said that there was formerly an excellent haven in Cape Lookout, which, since the year 1777, has been completely filled up with land. The best of the bad harbours now to be met with in North Carolina, is Wilmington.

which admits vessels of 300 tons burden; but the entrance to it is rendered extremely dangerous and difficult, by a large shoal, to which mariners have given the name of Cape Fear. The north-eastern branch of the river Fear is navigable as far as Fayetteville, one hundred miles beyond Wilmington, for vessels of eighteen or twenty tons burthen. This is the greatest river navigation in the state, and serves greatly to enliven the trade of Wilmington. A considerable traffic is carried on between this port and the Antilles; and European goods are conveyed thither from Charleston, Baltimore, and Norfolk. The exports of Wilmington amounted, in 1791, to 258,728 dollars; in 1792, to 262,498 dollars; in 1793, to 171,569 dollars; in 1794, to 133,167 dollars; and in 1795, to 254,151 dollars.

Next to Wilmington, the most considerable ports are Newbern and Edenton. Newbern is seated on the river Neus, at its confluence with the Trent, about one hundred miles from the sea, from which the whole coast of North Carolina is separated by long and small islets from Cape Lookout to the borders of Virginia. The exports of Newbern amounted, in 1791, to 105,685 dollars; in 1792, to 101,367 dollars; in 1793, to 60,695 dollars; in 1794, to 69,617 dollars; and in 1795, to 73,652 dollars.

Edenton is situated on the river Roanoke, near the point of Albemarle Sound, about 150 miles from the islet which takes its name from the Roanoke. Ships of 150 tons burthen can sail a few miles above Edenton. Its exports amounted, in 1791, to 92,306 dollars; in 1792, to 87,203 dollars; in 1793, to 59,576 dollars; in 1794, to 50,648 dollars; and in 1795, to 77,907 dollars.

From the books of the custom-house, it appears, that in 1791, the total amount of the exports from North Carolina was 524,548 dollars; in 1972, 227,899 dollars; in 1793, 365,414 dollars; in 1794, 321,587 dollars; and in 1795, 492,161 dollars. Of the produce of the back country, a great proportion is conveyed to South Carolina and Virginia; the southern interior counties send their produce to Charleston, and the northern to Petersburg in Virginia. The exports from the lower parts of the state are tar, pitch, turpentine, rosin, Indian corn, boards, scantling, staves, shingles, furs, tobacco, pork, lard, bees-wax, myrtle-wax, with a few other articles. The commerce of North Carolina is chiefly with the West Indies and the northern states. From the former, it receives rum, sugar, and coffee; from the latter, flour, cheese, cider, apples, potatoes, ironware, cabinet articles, hats, teas, and dry goods of all kinds imported from Great Britain, France, and Holland.

Like all the southern states of United America, North Carolina has a considerable diversity of climate, occasioned by the physical peculiarities of its different parts. In the level part of the country, intermittent fevers are frequent during summer and autumn; which, though seldom immediately dangerous to those whose constitutions are not injured by intemperance, yet, if neglected at first, invariably bring on other disorders. which destroy the vigour both of mind and body, and generally terminate in death. During these sickly seasons, the countenances of the inhabitants have a pale yellowish hue, occasioned by the prevalence of bilious affections. Yet more fall victims during winter, to pleurisies and peripneumonies, than to the fevers occasioned by the heats of summer. Physicians allege, that these fatal diseases, which are generally brought on by intemperance, and an imprudent exposure to the weather, might in general be escaped by sobriety and caution. The use of flannel next to the skin, they recommend as an excellent preventative of the diseases incident to this climate and season. In the western hilly parts of the state, the air is as pure and salubrious as in any part of America, and the inhabitants in general live to a great age. The heat of the summer's day is succeeded in the evening by a grateful and refreshing coolness; autumn is temperate and serene; and in some years the winters are so mild, that autumn may be said to continue till spring. Wheat harvest commences in the beginning of June, and that of Indian corn early in September.

When the conduct of the British government had roused the Americans to an assertion of their independence, a constitution was framed for each individual state, by its representatives assembled in congress. The constitution of North Carolina, ratified in December 1776, vests all legislative authority in two distinct branches, both dependent on the people, viz. a Senate, and House of Commons. Each county in the state is represented in the Senate by one member, chosen annually by ballot; and in the House of Commons by two members, elected in the same manner. The towns of Edenton, Newbern, Wilmington, Salisbury, Hillsborough, and Halifax, have each, likewise, the privilege of having one representative in the House of Commons. The Senate and House of Commons, assembled for the purpose of legislation, are styled the General Assembly. No person can be elected a senator who has not resided at least one year immediately before the time of election in the county which he wishes to represent, or who does not possess there 300 acres of land in fee; and those who vote for his election must be freemen, not below twenty-one years of age, who have resided in the state one year previous to the day of election, and have possessed a freehold of fifty acres of land, for at least the last six months of that time. The candidate for a seat in the House of Commons must have resided one year previous to the election in the county which he is to represent, and must have possessed for at least six months, and continue to possess, not less than 100 acres of land in fee, or for the term of his life; his election is decided by a majority of the freemen in the county, not under twenty-one years of age, who have resided in the state a year before the time of election, and have contributed their portion of public taxes. These two houses, when convened, choose each its own speaker, and decide on the qualifications and elections of their respective members. At their first meeting, after each annual election, they jointly choose by ballot a governor for one year, who is not eligible to that office oftener than thrice in six successive years. The governor must possess a freehold of more than 1000*l.* and must have resided in the state at least five years. At the same time, and in the same manner, they elect a council of state, consisting of seven persons, to assist the governor in discharging the duties of his office. They appoint one or more treasurers for the state; a state secretary, who continues in office for three years; judges of the supreme courts of law and equity, judges of admiralty, and an attorney-general, who are commissioned by the governor, and hold their offices during good behaviour. Intended laws must be proposed in the form of bills, which must be read three times in each house, and signed by the speakers, before they can be enacted.

Judges of the supreme court, members of council, judges of admiralty, treasurers, secretaries, attorney-generals for the state, clerks of record, clergymen, receivers of public money whose accounts are unsettled, military officers in actual service, and persons who deny the being of God, the truth of the Protestant religion, and the divine origin of the Old and New Testament, cannot hold a seat either in the Senate or House of Commons. No business can proceed in either house, unless a majority of its members be present.

We are not able to state precisely what the public expenditure of this state may be at present. A few years ago, it fluctuated from about 38,000, to 45,000 dollars. The public debt, which was chiefly contracted during the revolutionary war, consists in bills of credit to the amount of 150,000*l.*, which are either in the treasury, or in circulation. By the determination of the commissioners, the debt, which the Union owes to this state, amounts to 500,882 dollars, or 200,752*l.* sterling. The money necessary for the exigencies of the state is raised by the following taxes: 1. Eight-pence for every hundred acres of land, whatever its situation or quality may be. 2. Two shillings for every hundred pounds of taxable property, in town lots. 3. Two shillings for every inhabitant, whether white or black, freeman or slave, from 12 to 15 years of age. 4. Ten shillings for every stallion. 5. Forty shillings for the licence to keep a tavern, or for selling spirituous liquors. 6. For every sentence or decree, from eight to twenty shillings, according to the different courts by which it is pronounced. The justices of the peace are, in virtue of their office, collectors of the taxes; they receive six per cent. on the amount of the taxes which they collect, and sixpence for every mile which they travel on that errand. In 1795, the taxes amounted to 18,447*l.*, 4*s.* sterling, or 39,200 dollars, in the following proportions: The taxes on town lots, to 2500 dollars; on lands, to 6386*l.* 10*s.* sterling; the poll-tax, 25,400 dollars; the taxes on law suits, billiards, and horses, 2500 dollars; making in all 46,118 dollars, or 18,447*l.* 4*s.* sterling. Deducting from this sum the expences of collecting the taxes, and the loss arising from defaulters, there remains a neat surplus of 15,681*l.* sterling, or 39,200 dollars.

In North Carolina, as in all the other states of the Union, the establishment of any religious sect or denomination, in preference to others, is expressly prohibited by the constitution. The western parts of the state, which have been settled within the last 50 years, are chiefly inhabited by Presbyterians from Pennsylvania, the descendants of people from the north of Ireland. The Moravians form a very numerous sect, and have many flourishing settlements in the state, particularly in Surry county, between the rivers Dan and Yadkin. The Quakers have a settlement in New Garden, in the county of Guilford, and several congregations in Perquimins and Pasquetank. The Methodists and Baptists are numerous, and are daily making converts. In the districts of Wilmington, Newbern, Edenton, and Halifax, the inhabitants, amounting to about three fifths of the population of the state, profess themselves of the Episcopal persuasion. At present, however, they have no house for public worship, nor is there much external appearance of religion among them in general.

The character of the North Carolinians is neither respectable nor engaging. Indolence and indifference are their prevailing dispositions;—dispositions which display themselves not only in the slovenly and inactive manner in which they conduct their secular business, but in their general neglect of religion. The Sabbath is disregarded, or is distinguished only by the convivial mirth of the white inhabitants, or the noisy diversions of the negroes. The women, though remarkably affectionate, mingle but little in society; nor are they treated with that respect and attention which is universally paid to their sex in more civilized countries. The men, of course, want that polish and refinement of manners, which the society of the fairer part of our species, and an anxiety to win their regard, alone can impart. Living on their plantations, at a considerable distance from each other, and in a state of seclusion from the world, they delight to meet together in convivial parties, and enjoy the visit of a stranger with a relish which displays itself in the most unbounded hospitality. But even in their hospitality there is a coarseness, which can only be redeemed by the benevolence which it indicates; and their conviviality almost invariably degenerates into gross intemperance. Drinking, gambling, and every species of dissipation, engross the time and the attention which should be employed in the culture of their plantations, or the improvement of their minds. To the amusements of cock-fighting and horse-racing they are as passionately addicted as our keenest British sportsmen; and enjoy the spectacle of a boxing-match, in a style of perfection of which our most knowing ones have scarce an idea. When two Carolinian pugilists have exhausted their strength in fair bruising, they have at length recourse to *gouging*, which is thus performed. Each of the combatants endeavours to twist his fore-fingers in the ear-locks of his antagonist. When these are fast clenched, the thumbs are extended each way to the nose, and the eyes gently turned out of their sockets. The victor, for his expertness, receives shouts of applause; while his eyeless antagonist is laughed at for his misfortune. We regret, for the honour of humanity, to state, that this shocking entertainment is not confined to North Carolina, but is sometimes enjoyed by the lower classes in its sister province and in Georgia.

From this short sketch of the manners of the North Carolinians, it will easily be perceived that the education of their youth is an object of little attention. There is not, in the whole state, a single college or university; a defect which is the less excusable, as it is expressly enjoined in the original constitution, that "there shall be one or more seminaries of learning maintained at the public expence." Academies or schools, however, have been established at Newbern, Salisbury, and Hillsborough. The academy at Salisbury had, in 1786, about fifty scholars, under the tuition of a clergyman. The number of students in Hillsborough may be from 60 to 80: what number there may be in Newbern we have not been able to ascertain.

The increase of population in North Carolina has been amazingly rapid. In the year 1710, it contained no more than 1200 fencible men: and in 1810, it contained 563,516 inhabitants, and is, in regard to population, the fourth state in the union. To this rapid increase of numbers, successive emigrations from Pennsylvania, Virginia, and other states, have greatly contributed. Now, however, the increase arises more from its own stock than from emigration; for, though colonists do arrive from these quarters as formerly, many settlers, on the other hand, emigrate again to Georgia, South Carolina, Kentucky, and Tennessee.

The towns in this state are few, and of little importance. Newbern, Edenton, Wilmington, Halifax, Hillsborough, and Fayetteville, are the most considerable, and have each, in its turn, been regarded as the capital. Since 1788, the seat of government has been fixed at Raleigh. (*a*

CAROLINA, South, one of the United States of America, is bounded on the north and north-east by North Carolina, on the south and south-west by Georgia, and on the east by the Atlantic ocean; extending from the 32° to the 35° of north latitude, and from the 78° to the 81° of west longitude from London. Its limits may be more minutely traced as follows. Its northern frontier is determined by a line commencing at a cedar stake, marked with nine notches, on the shore of the Atlantic ocean, near the mouth of Little River. It then pursues, by many traverses, a course W. N. W. till it reaches the fork of Catauba river; and next runs due west to a point of intersection in the Apalachian or Alleghany mountains. It thence takes a southerly direction, till it meets the Chatuga, the most northern branch of the Tugoloo river, and then proceeds along the Tugoloo to its confluence with the Keowee. From this point it stretches along the Savannah, till that river flows, by its most northern mouth, into the Atlantic ocean. It then runs north-east along the Atlantic, including the islands which stud its shore, till it intersects the northern boundary, near the entrance of Little River. These boundaries include an area, somewhat triangular, of about 2480 square miles.

South Carolina is divided by nature into two parts, which, from their physical situation, have been called *Upper* and *Lower* Carolina. Towards the coast, the country is a level plain, extending more than one hundred miles westward from the ocean. Here the eye finds no relief from the dull uniformity of boundless forests, swamps, and level fields. This fatiguing plain is succeeded by a curious range of little sand-hills, exactly resembling the waves of an agitated sea. This singular country occupies an extent of about sixty miles. It is extremely barren,—enlivened here and there by spots of verdure, or by some straggling pines; and its few inhabitants earn a scanty subsistence by the cultivation of corn and sweet potatoes. After passing these sand-hills, we come next to a remarkable tract of ground, which, on its approach from the sea, is lofty and bold, but on the north-west is level from its summit. This tract, called the Ridge, is a fine belt of land, extending from the Savannah to Broad River; fertile, well cultivated, and watered by some considerable streams. The country beyond this ridge resembles, in its scenery, the most interesting of the northern states. The traveller is perpetually gratified by the pleasant alternation of hill and dale; the lively verdure of the hills is contrasted with the deeper tints of extensive forests which decorate their sides; and in the vallies, broad rivers roll their shining streams through the varied beauties of luxuriant and highly cultivated fields. From these delightful regions, the ground still continues to ascend; every hill we pass yields in height to its successor:

> "Hills peep o'er hills, and Alps on Alps arise;"

till, after many a toilsome step, we reach at length the western terminating point of the state.

As the coast of South Carolina forms the base of the triangle which its boundaries describe, only its apex, containing four of the 25 districts into which the state is divided, can properly be called mountainous. The districts of which this apex consists, are Pendleton, Greenville, Spartanburg, and York. Here seven or eight mountains run in regular direction, the most distinguished of which is Table Mountain, in the district of Pendleton. This stupendous mountain, towering to the height of 3000 feet from its base, and 4000 above the level of the sea, presents on one side an abrupt precipice of solid rock, nearly perpendicular; at the bottom of which is a dismal valley, apparently sunk as much below the level of the surrounding country, as the mountain rises above it. The precipice, viewed from the valley, appears like an immense wall stretching up to heaven; and the awe which it inspires is considerably increased by the quantities of bones which lie whitening at its base, the remains of various animals which had incautiously approached too near its edge. The summit of this mountain is frequently enveloped in clouds. In winter, prodigious masses of snow tumble from its sides, the sound of which is heard at the distance of seven miles. Its forests produce excellent mast. They are frequented by wild pigeons in such flocks as sometimes to break the limbs of the trees on which they alight. The upper regions are the resort of deer and of bears. Oolenoy Mountain, in the vicinity of the Table Mountain, is remarkable for a cataract, the descent of which is from 600 to 700 feet. Oconee mountain, near the head-waters of the rivers Keowee and Tugoloo, is five or six hundred yards above the adjacent country. Between this and Table Mountain the country is generally wild, but the vallies are highly cultivated, and so fertile as to produce, in many instances, 100 bushels an acre. On a stream which flows among these mountains, there are several fine waterfalls. From one of them in particular, which is about 130 feet high, the water dashes with such violence, as to occasion a current of air which keeps the leaves in perpetual agitation, and to scatter a spray, like rain, to a considerable distance around. The other considerable mountains of South Carolina are Paris's mountain, in Greenville district, from which issues a spring impregnated with iron and sulphur, said to be efficacious in curing ring-worms, and other diseases of the skin; the Glassey and Hogback mountains, situated near the boundary line of Greenville and Spartanburg, from which issue the streams which form the sources of the Tyger and Pacolet rivers; and King's mountain, in York district, on which has been discovered the real limestone rock. These mountains afford a profusion of rich grass, and are clothed to their summits with lofty forests. Copious streams of the finest water pour from their sides; and the intermediate vallies, though small, are amazingly fertile. The boundless view of the champaign country, becoming more level as it approaches the sea, is finely contrasted with the wild irregularities of those immense heights which diversify the western extremity of Carolina.

Though but a small part of this country is occupied with mountains, every part of it is intersected by rivers. Towards the sea it is watered by the Waccamaw, Pedee, Black River, Santee, Wandow, Cooper, Ashley, Stono, Edisto, Asheppo, Combakee, Coosaw, Broad and Savannah rivers. Most of these rivers have a margin of swamp, extending from half a mile to three miles. All of them run in a south-eastern direction from their heads to the sea. Broad river, Coosaw, Port Royal, and other short rivers, are properly arms of the sea, deep, and of easy navigation. Broad and Port Royal Rivers can accommodate a large navy with convenience and safety. Wandow river, which flows into the Cooper about three miles above Charleston, is navigable for about twenty miles. Cooper river may be navigated for about fifty miles by schooners and sloops; and its eastern branch is navigable for a considerable way to vessels of a similar description. Where it empties itself into Charleston harbour, it is about one thousand four hundred yards broad. The harbour is formed by the junction of the Cooper with the Ashley river, which, rising in the Cypress, and other contiguous swamps, expands opposite Charleston to a width of two thousand one hundred yards. To vessels of considerable burthen it is navigable for only a few miles, but admits of sloops and schooners for many miles higher. The Savannah river is bold and deep. Boats of seventy tons burthen can advance on this river from the sea to Augusta, in the upper district of Georgia. Here the falls of the river commence, beyond which the navigation continues for boats of 30 tons to Vienna, sixty miles higher. The Santee is navigable from the sea to the fork of the Congaree and Wateree rivers; thence up the Wateree to Camden on one side, and up the Congaree to Granby on the other, for boats of seventy tons. At these places the falls and rapids commence; the upper branches of the rivers are dispersed extensively over the country. Though sometimes obstructed by rocks, their current is in general deep and gentle. In full rivers, light boats, containing several hogsheads of tobacco, have been floated down their streams with safety. The Pedee river, stretching from the sea towards the mountains, through the northern part of the state, is navigable to vessels of seventy tons as far as Greenville to Chatham. There the navigation is obstructed by rocks and shallows, though, in full rivers, boats of light burden descend with the stream from North Carolina. The Stono, Asheppo, Combakee, Edisto, and Black rivers, though much inferior to those which we have mentioned, are all navigable for some miles, and greatly facilitate the internal communication of different parts of the country. The large rivers spread themselves, by innumerable tributary streams, throughout the upper country. Some of their branches are even wider than the rivers themselves. Keowee, though two hundred yards wide for several miles above its confluence with the Tugaloo, is the narrowest of these two streams, whose united waters take the name of Savannah river.

In most of the upper districts, but especially in those at a moderate distance from the mountains, amazing facilities are afforded for mills, and other machinery. The springs which issue from the sides of the mountains, after running sixty or seventy miles, become streams from 100 to 200 yards in breadth. These, as they spread wide, have many shoals, and are so shallow as to be generally fordable. At many of those shoals the falls are sufficient, with the the aid of a small dam, to impel the most weighty machinery. At some of them the falls are so great and so abrupt, as to admit twenty feet wheels upon the overshot construction, without any races, or, at most, with very short races; and, at others, the ledges of rocks form a natural dam, quite sufficient for obstructing as much water as is necessary to drive any kind of mill. Besides these rivers, smaller streams called creeks spring from the foot of the hills; and with the advantage of their falls, are sufficiently powerful to impel machinery of any magnitude. The inhabitants are now beginning to avail themselves of these natural advantages. Many valuable machines have been erected for improving and facilitating labour, particularly saw-mills and corn-mills; though it must be owned, that their improvement in manufactures have by no means kept pace with their progress in wealth, and are far from being adequate to their opportunities.

Almost the only lake of which South Carolina can boast, is a sheet of water in Barnwell district, nearly a mile in circumference. In several places, the large rivers have broken through peninsulas formed by their streams, and work a channel as wide and deep as the circuitous channels in which they formerly flowed. When the mouths of these channels are partly choked up, and the streams in them become slow, they are denominated lakes. Such is Lowder's lake on Pedee river, over which the surrounding lands project elevations of near one hundred feet.

Along the coasts of South Carolina, neap tides rise, in common weather, from six to eight feet; and spring tides from eight to ten. They are much influenced, however, by the wind; for, with a south-easterly wind, neap tides rise higher than spring tides when it blows from the northwest. The depth of water for some miles from the shore, is from two to five fathoms. In rivers, whose streams are not impetuous, the tides ascend from thirty to thirty-five miles in a direct line from the sea. In the Santee and Savannah, the influence of the tide is not perceptible for more than fifteen miles; and the powerful column of water which they pour down, makes them retain their freshness till within two miles of their disemboguement.

The mineral productions of this country have not yet, perhaps, been sufficiently explored; but those which are known are of considerable importance. Asbestos is found near the sources of Lynche's creek. Soap-stones, steatites, rock crystal, white flint, fuller's earth, clays of different kinds and of beautiful colours, potter's clay, isinglass, ochres, chalks, and marls, have been found in different parts of the state. At Beaver's creek, there is a quarry of grey stone resembling freestone, which works well, and splits easily. Rocks suitable for millstones are common in the upper country; good slate has been found in some places; and some fine clay was brought to Charleston, about the year 1760, from the Cherokee country, which, being sent to England by Dr Garden, was manufactured into a tea equipage, equal to the finest imported from China. The upper country, particularly the mountainous districts, abound with iron ore of so good a quality, as to yield a fourth of its weight in excellent iron. The Cherokee mountains furnish great abundance of lead ore, so rich as to produce two-thirds of its crude weight in pure lead. Specimens of copper and of several other metals have likewise been found, and mines of these metals might perhaps be wrought with advantage. There are many valuable medicinal springs within this state, some of which are rising into fame; but their component parts and real virtues have not hitherto been ascertained with satisfactory precision.

Many circumstances concur to render it probable, or rather certain, that all the low country of Carolina has once been under the dominion of the ocean. In the deepest descent into the ground, neither stones nor rocks are ever discovered. The strata generally consist of rocks or beds of shells, with which petrified fish are sometimes found intermixed at a considerable depth from the surface. Extensive beds of oyster shells have been discovered at a great distance from the present limits of the sea shore. The most remarkable of these extends from Nelson's ferry on the Santee river, sixty miles from the ocean, in a south west direction, passing through the intermediate country, till it crosses the Savannah river in Burke county, and continuing on to the Oconee river in Georgia. These shells are uncommonly large, and quite different in kind from the oysters now found on the shore of Carolina. They lie about seven feet below the surface: the incumbent stratum consists of common earth: below the oysters, the soil, for the next four feet, is a whitish coloured mass, intermixed with shells; a blue hard substance resembling stone succeeds for the next three or four feet; and under this is sand, the depth of which is unknown.

In the cuts which have been made across peninsulas, for the purpose of facilitating inland navigation, prodigious quantities of cypress timber are sometimes discovered, affording unequivocal evidence that the country had formerly been covered by immense forests of that species of wood. A circumstance still more calculated to excite the wonder and curiosity of the naturalist, is the discovery, in these excavations, of the bones of monstrous animals, unlike to any which are now known to exist. These bones were found in digging the Santee canal, about eight or nine feet under the ground, and lying so near together, as to render it probable that they originally belonged to the same animal. The enormous dimensions of this animal may be conjectured from the size of its ribs, one of which, when dug up, was nearly six feet long, and from one of its jaw teeth, which was 8¼ inches long, 3½ inches wide, and its root 11½ inches long. The depth of the tooth, from its surface to the bottom, was 6½ inches. The other parts of the skeleton were in a relative proportion.*

The coast of Carolina is intersected by inlets, creeks, and marshes, from the meanderings and junctions of which many islands are formed. Of those islands some are increased on their western extremities by accretions, and diminished on their eastern border by the dashing of the ocean. On those which are contiguous to the main, monuments of Indian antiquity are occasionally discovered. There are other islands entirely of marine origin, which appear to be accumulations of recrements thrown up by the action of the Atlantic waters. The mainland, contiguous to these islands, has a surface of light black earth upon a stratum of sand. For 80 or 100 miles it is quite free of stones; and has a gradual ascent, which, at least for a considerable distance from Charleston, has been ascertained, with mathematical precision, to be three feet in a mile.

The soil of South Carolina is naturally, as well as politically, divided into six classes: 1. Tide swamp. 2. Inland swamp. 3. High river Swamp, or low grounds, distinguished by the name of second low grounds. 4. Salt marsh. 5. Oak and hickory high land. 6. Pine barren. The two first classes are peculiarly adapted to the culture of rice and hemp; the third is most favourable to the growth of hemp, corn and indigo. The salt marsh has hitherto been much neglected, though there is every reason to believe that it would amply repay the trouble of cultivation. The oak and hickory land is remarkably fertile, and is well adapted to the culture of corn, as well as of indigo and cotton. The pine barren, though the least productive, is so much more salubrious than the other soils, that a proportion of pine barren is an appendage indispensably necessary to every swamp plantation. It is remarkable, that this species of soil, though comparatively barren, bears pine trees of the largest growth, which maintain their verdure through winter, and, as Dr Ramsay justly observes, administer more to the necessities and comforts of mankind, than any other species of tree whatever. The cause of this seems to be, that the pine land is only superficially sandy; for, on digging into it a few feet, the soil is found to change, in many places at least, from sand to clay. The tide swamps are so level, that a few inches of water can frequently cover them sufficiently for agricultural purposes. In the legal valuation of the land for taxation, these lands hold the first rank. As the swamps above the influence of the tide are subject to river floods, which the Americans call *freshets*, they are somewhat precarious, but in other respects are of immense value. The sand hills in the middle country are so extremely barren, as to produce scarcely a pile of grass. On the low grounds between them, however, a rich mould is frequently deposited; and the margins of the rivers which flow among them are always abundantly fertile. The hills of Santee, situated likewise in the middle country, are elevated two hundred feet above the adjacent lands. Their soil, which is a mixture of sand, clay, and gravel, is admirably adapted to the culture of highland grain and cotton; and affords to the inhabitants the pleasures of health, and the various comforts of life, in a greater combination than is common in the southern states.

Agriculture, though the grand business of Carolina, is far from having reached the perfection of which it is susceptible. The art of manuring land is little understood, and even less practised. Most of the planters, relying on the fertility of the soil, of which they have generally extent enough to enable them to change what begins to fail for that which is fresh, seldom give themselves much trouble to keep their fields in heart. So little was the value of manure understood only twenty years ago, that it had no fixed price in Charleston, but was often given to the first who chose to carry it off. To their cattle, hogs, and sheep, they pay little attention. Allowed to roam at large in the woods, where they find abundance of excellent food and shelter, they depend but little on the care of their owners, and can hardly be regarded as domesticated animals. Hence it often happens, that a planter, who possesses twenty or thirty milch cows, derives less advantage from them, than cottagers derive in other countries from two or three, which they tend with proper care. Much valuable high land remains yet unbroken. Extensive marshes, which might easily be converted into productive rice swamps, are left in a state of nature. Indeed, it is only a small proportion of the ground lying on the margins of rivers and of swamps, that has yet been brought under proper cultivation. Immense forests of pine land, which have hitherto produced little else than lumber, might, with the help of manure, be made to produce abundance of kitchen vegetables, with good crops of corn, potatoes, and turnips; and, instead of remaining unproductive deserts, might be improved to the support of a numerous and healthful peasantry. Rice, which is the most nutricious and useful aliment made use of by man, is the grand staple in the agriculture of Carolina. It was introduced into that country about the year 1693, by Landgrave Thomas Smith, who, having procured a bag of rice from the cook of a vessel from Madeira, that anchored near Sullivan's island, sowed it in a spot of moist low ground at the bottom of his garden. It grew luxuriantly. The crop was distributed among his planting friends; and in a few years rice became the chief support of the colony. The variation in the amount of the crops of this valuable aliment forms an important document in the history of South Carolina; for it has been materially affected, not only by the introduction of other staples, but by the political changes of the country. When it was first introduced, the number of negroes in the province was small, the government was unsettled, and the kind of soil and mode of culture most favourable to its growth were unknown. For twenty years after its introduction, its exportation was rendered so hazardous by the ravages of pirates on the coast, that it was not cultivated to any great extent. In the year 1724, about six years after the suppression of the Buccaneers, 18,000 barrels of rice were exported; and each succeeding year brought an additional quantity to market. The quantity exported in 1740 was 91,110 barrels; in 1754 it amounted to 104,682 barrels. Hitherto rice had been the chief article of export from Carolina; but soon after the middle of the 18th century, much of the attention of the planters was transferred from it to indigo. The culture of rice, however, continued to advance, though slowly, till the commencement of the American revolution, when the average quantity annually exported was about 140,000 barrels. In 1783, the first year after the evacuation of Charleston, the crop of rice amounted to only 61,974 barrels. From that time its cultivation was resumed with vigour, and the annual exportation of it continued to increase till the year 1792, when the quantity exported amounted to 106,419 barrels. The culture of cotton now began to employ so much of the agricultural force of the state, that the crops of rice since that period have rarely exceeded what they were about the middle of the 18th century.

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* Similar bones have been found in various parts of America; as Kentucky, the banks of the Ohio and Missoure, and the north-western territory.

Next to rice, the most important article of agricultural produce in South Carolina, for a long time at least, was indigo, which was first introduced about the year 1742. The cultivation of this plant went on with such spirit and success, that, in the year 1747, a considerable quantity of it was sent to England; and, in the following year, a bounty was obtained from parliament of sixpence per pound on indigo, raised in the British American plantations, and imported directly into Britain from the place of its growth. Thus encouraged, the planters of Carolina proceeded in the cultivation of indigo with such spirit and success, that the export of this article amounted, in 1754, to 216,924 lbs.; and before the revolution, it had risen to 1,107,660 lbs. Though neglected during the war, the cultivation of it was eagerly resumed after the restoration of peace; and it continued for some years to form a valuable export, till its price was greatly lowered, by large importations of the same commodity from the East Indies into England. The attention of the planters was, towards the close of the 18th century, directed to cotton; and as the same soil was adapted to the cultivation of both it and indigo, the latter was in a great measure neglected for the new staple.

Though the climate of Carolina was known to be similar to that of the East Indies, where cotton had grown abundantly for many centuries; though Dr Hewat, in his valuable history of South Carolina, had declared, so early as 1719, that the climate and soil of the province were favourable to the culture of cotton, and though the first provincial congress, held in January 1775, had recommended to the inhabitants the raising of that useful plant; yet a very trifling quantity only was raised for domestic manufactures, previous to the year 1795. In that year, however, cotton was exported to the amount of 1,109,653*l*. Since that time the quantity of cotton raised has been annually increasing; and, in the first year of the present century, eight millions of pounds of it were exported from South Carolina. Two kinds of cotton are raised in South Carolina. On the level lands of the low country, the kind chiefly cultivated is the black seed, or long staple cotton, which is admirably adapted to the finest manufactures. The wool is easily separated from the seed by roller-gins, which do not injure the staple. In the middle and upper country, the cotton universally cultivated is the green seed kind, which is less silky, and adheres so tenaciouly to the seed, that it cannot be separated without the action of a saw-gin. This cuts the cotton exceedingly; but as this kind is unfit for the finer fabrics, the cutting is scarcely considered injurious. Though the wool of the green seed cotton be cheaper than the other, it grows likewise more luxuriantly. An acre, which will produce 150 lbs. of black seed cotton, will generally yield 200 lbs. of the green seed kind.

These staple articles have so engrossed the attention of the planters, that the culture of wheat, barley, oats, and other crops, equally useful but less profitable, has been almost wholly neglected. So little wheat is raised throughout the state, that considerable quantities of it are annually imported. Barley has occasionally been cultivated with such success on the low grounds that seventy bushels have been procured from an acre; and as it ripens there early in May, another crop might easily be raised on the same ground in the course of the year. Nothwithstanding these advantages, however, the culture of this grain has not been pursued with any degree of spirit. Hops are annually raised in small quantities, and the cultivation of them might easily be carried so far as to answer any probable demand. As mulberry trees grow in Carolina spontaneously, and native silkworms, producing well-formed cocoons, are often found in its woods, there can be no doubt that the country is naturally adapted to the raising of silk. For a considerable time the culture of silk was carried on by the Swiss colonists near Purysburgh, and occasionally by private persons as late as the year 1787. At present it is successfully continued at New Bourdeaux in Abbeville; but the conviction that greater profits may be obtained more easily by other means, has prevented the culture of this commodity from being carried to any great extent.

The soil is well adapted to the cultivation of the vine and olive trees; for the woods abound with native grapes, from which, as well as from the fruit of imported vines, wine has been occasionally made: and from the olive trees which have been naturalised in Carolina, olives are prepared and preserved equal to any that can be imported. The culture of these excellent fruits, however, has been almost entirely neglected, in the general eagerness of the planters to have extensive crops of the more profitable articles, rice and cotton. Hemp and flax have been raised in considerable quantities, and in the year 1784 were noted as articles of export, though only to the trifling amount of three tons of the former, and 171 casks of the latter. Tobacco, which is an indigenous plant of America, thrives remarkably well in Carolina. The exportation of it amounted in 1799, to 9646 hogsheads, and it might be raised to any extent; but the superior value of cotton has left the culture of tobacco comparatively neglected. The soil, both of the swamps when completely drained, and of the highlands, is admirably adapted to the growth of maize or Indian corn. But the culture of that grain, which is considered as a more nutritious aliment for labouring people than even rice, has given place to that of cotton, and it is even imported in great quantities on the sea-coast for domestic use.

Such are the articles of agricultural produce in Carolina, with the relative importance assigned to them by the planters. The genial soil of that country is equal to almost any production, and with proper culture might be made to yield at least ten times its present value. A society was incorporated in 1785, for the purpose of promoting the improvement of agriculture. Their object was to appropriate a farm to agricultural experiments, to import and circulate such exotics as were suitable to the climate of Carolina, and to award premiums to those who introduced any important improvement into the art. Till lately their efforts were much restrained by the want of funds, but this obstacle has been removed by the successful issue of a lottery, established for the benefit of the institution. The society is now clear of debt, and possesses a farm of forty-two acres in the vicinity of Charleston, in which agricultural experiments are occasionally made. It consists of forty members, whose annual subscription of twenty-five dollars each, added to the proceeds of the late lottery, will enable them to proceed with vigour in the objects of their association

The period of vegetation in Carolina comprehends, in favourable years, from seven to eight months, commencing in January and February, and terminating in October or November. The frosts which generally prevail in the months of November, December, January, and February, are too severe for the delicate productions of more southern latitudes. Carolina cannot be reckoned a remarkably good fruit country, yet there is scarcely a month of the vegetating season which does not furnish some species of fruit. Blackberries, strawberries, raspberries, and apricots, are ripe in April and May; plumbs, blackberries, early pears, apples, peaches, figs, and nectarines follow; water melons and musk melons continue from June to October; pomegranates, late peaches, pears, apples, grapes, and winter plumbs, come in towards the termination of the hot weather; haws, sloes, and fox grapes, in October; chinquapins, chesnuts, and persimons, still later. Gooseberries, currants, and cherries, have never grown to any purpose in the low country. Wild cherries are common in the woods, but in gardens, cherry trees, though they grow well, have never good crops of fruit. Figs, apricots, nectarines, apples, pears, peaches, olives, pomegranates, almonds, and the pechan or illinois nut, though exotics, have been naturalized to good purpose in Carolina, and endure all the varieties of season; orange trees can stand the frosts of ordinary winters, but in very severe seasons their stems are occasionally destroyed. No species of fruit thrives so well in this country as pears, pomegranates, and water melons; the latter, in particular, grow to an enormous size, and are superior perhaps to any in the world.

The forests of South Carolina abound with many valuable species of timber; and its fields yield a profusion of plants, whose curious structure, singular beauty, or medicinal virtues, render them alike interesting to the botanist and physician. Of these Dr Ramsay has given an extensive list, which we regret that our limits will not allow us to transcribe.

Of the aboriginal animals of South Carolina, several species have disappeared. Of those which remain, the most remarkable are the bear, panther, wild cat, wolf, beaver, grey fox, red deer, otter, wild rat, black squirrel, grey squirrel, flying squirrel, ground squirrel, polecat, mink, opossum, racoon, lizard, alligator, scorpion, toad. The following animals have been imported and domesticated: the cow, horse, ass, hog, sheep, dog, and cat.

Of the immense variety of birds with which South Carolina abounds, the most remarkable are, the bald eagle, fishing hawk, pigeon hawk, grey hawk, swallow-tailed hawk, night hawk, turkey buzzard, carrion crow. large owl, screech owl, Carolina cuckoo, perroquet, blue jay, purple jackdaw, red-winged starling, or blackbird, rice bird, large white bellied woodpecker, gold winged wood pecker, red bellied wood pecker, hairy wood pecker, yellow bellied wood pecker, small spotted wood pecker, nut hatch, great and small sanguillah, wild pigeon, turtle dove, ground dove, May bird, robin, thrush, Carolina bull-finch, large swamp sparrow, little sparrow, snow bird, mocking bird, blue grosbeak, purple finch, painted finch or nonparcil, blue linnet, chatterer, blue bird, crested fly-catcher, black cap fly-catcher, swamp red bird, highland red bird, summer red bird, crested titmouse, yellow titmouse, pine creeper, yellow throated creeper, humming bird, king fisher, chattering plover or kill deer, whistling plover, hooping crane, blue heron, little white heron, crested bittern, cormorant, white curlew, brown curlew, oyster catcher, Canada goose, small white brant goose, great grey brant goose, duck and mallard, canvas-back duck, (found in Carolina every spring,) gannet, large black duck, ball neck duck, round crested duck, summer duck, little brown duck, blue winged teal, white-faced teal, black cormorant, flamingo, water pelican, wild turkey, pheasant or mountain partridge, small partridge or quail, wren, swallow, martin, whip poor-will or goat-sucker, snipe, wood cock, marsh hen, Indian pullet.

Many species of serpents, some of them of the most dangerous kind, are natives of South Carolina. Among these are, the rattle-snake, water rattle-snake, small rattle-snake, water viper, copper belly snake, bluish green snake, hog nose snake, wampum snake, horn snake, thunder snake, black snake, little brown head snake, ribbon snake, chain snake, mogason water snake, coach whip snake, corn snake, green snake, glass snake, bull snake.

The rivers and coasts of Carolina teem with many varieties of fish, some of them of the most delicate kinds. In the fresh water are found, sturgeon, pikes, trout, bream, roach or silver fish, pearch, sucking fish or carp, herring, cat-fish, garfish, rock fish, eel; and of shell fish, the soft shelled turtle, terrepin, and cray fish. In the sea which washes the coasts, are shark, porpus, drum, bass, sailor's choice, shad, sheep-head, crocus, whiting, porgy, black fish, soles, angel-fish, mullet, herring, skipjack, yellow tail, alewife. The shell fish found in the salt water, are some kinds of large and small sea turtle, oysters, crabs, shrimps, clams and muscles.

There is a frequent multiplication of fish in particular circumstances, which forms a remarkable peculiarity in the natural history of South Carolina. In every plantation, great care is taken in making drains to preserve water for overflowing the rice fields in summer. Soon after these ponds are made, they swarm with various species of fish. Various theories have been devised, to explain in what manner they breed, and whence they come. Some suppose, that their spawn is exhaled from the large lakes of fresh water on the continent, and being borne along in thunder clouds, falls with the drops of rain into these reservoirs of water. Others are of opinion, that the spawn has remained mingled every where with the sand, since these maritime parts of the continent were relinquished by the sea. While others imagine, that young fish are brought by water fowls from one pond to another, by which means the new made pools receive a plentiful supply. Of these theories, we are inclined to give the preference to the third; for we do not believe, that the specific levity of spawn is such as to admit of its being raised in vapour to the clouds; nor can we easily bring ourselves to think, that it could remain for ages in the sand, without being destroyed by putrefaction. None of these theories, indeed, appears to us at all satisfactory; but as the fact is notorious all over the country, its solution is worthy of the attention of naturalists.

By the degree and duration of its summer heat, South Carolina is allied to countries within the torrid zone; with those within the temperate latitudes, it is still more intimately connected by its winter's cold, and its general variableness. In tropical countries, the extremes of heat and cold are not removed from each other farther than by sixteen degrees of Fahrenheit's thermometer, so that there is but little distinction in point of temperature between their winter and summer. In South Carolina, there has sometimes been a difference of 83 degrees between the temperatures of different days in the same year, and the temperature has even varied 46 degrees in the course of one day. From 1791 to 1808, the difference between the coolest and warmest summers ranged from 88° to 93°, and the difference between the mildest and coldest winters, on a few particular days, from 50° to 17°. In Charleston and the low country, the degree of heat is considerably more moderate than in the interior parts of the state. At Columbia, in the summer of 1808, the mercury in the thermometer frequently rose to 96°, 97°, and sometimes to 98°, while at Charleston it did not exceed 91°. The number of extreme warm days in Charleston is seldom above thirty in a year, and three of such days scarcely follow one another in succession. On an average, there are about thirty sultry nights in the low country in the course of the year, when the heat and closeness of the air is such, as to prevent the enjoyment of sound sleep; but this severe heat is in general soon followed by cooling showers. Of piercing cold days, there are in general a greater proportion in winter, than there is in summer of those which are exceedingly hot; but of these, as of the severely warm days, more than three seldom come together. Within the last fifty years, the transitions from cold to heat have occasionally been so great and rapid, that the thermometer has been observed to fall more than fifty degrees in less than fifteen hours. The hottest day in the year is sometimes as early as June, sometimes as late as September, but most frequently in July or August. A stranger going to Carolina, should study to arrive there either in November or December; he should be particularly cautious not to make his first appearance there in summer, or in the first months of autumn. September, when the heat begins to abate, is more sickly than the preceding months, and the heat becomes then more oppressive. Perspiration is diminished and frequently interrupted, and the system, relaxed and debilitated by the relentless fervency of July and August, feels more sensibly and frequently an overpowering lassitude. The coolness of the evenings, and the heavy dews that then fall, multiply the chances of getting cold, so that it is upon the whole the most unpleasant, as well as the most dangerous, month in the year.

The low country is seldom covered with snow; but the mountains near the western boundary of the state are often mantled in that wintry robe. Frost sometimes binds up the earth, but seldom penetrates deeper than two inches, or lasts above three or four days. These transient frosts are succeeded by weather so mild, as to render fires unnecessary in the middle of the day. Such sudden and frequent changes affect the feelings and health of the inhabitants much more than equal or greater degrees of cold can do in countries where the climate is more steady, and the transitions more gradual. In February the weather is particularly variable. When a clear warm day has called forth vegetation, and inspired the hopes of an early spring, a north-west wind suddenly arises, accompanied with frost, and blasts the pleasing expectations. In this month rains are frequent. The planting season begins in March and April, and continues till June. In July and August, when the heats are most severe, heavy rains set in, accompanied frequently with violent storms of thunder and lightning. These thunder storms are said to be much less frequent and injurious now than they were about half a century ago. Yet during the summer, there are few nights in which lightning is not visible in some part of the horizon. The fury of the storm is generally spent on the lofty trees with which the country is covered; but the lightning sometimes does considerable damage to ships in the harbours, and is not unfrequently attended with showers of hail, so large as to break down the crops in the fields, and to shiver windows of glass. In September, which is the principal harvest month, storms of rain are frequent, and are sometimes accompanied by hurricanes, which prove extremely destructive.

The hygrometer in Charleston shews an almost constant humidity in the air. For seven years previous to 1809, it had not marked more than 24 dry days in any one year; and the average of the whole seven years was less than 16 dry days for each. The variation of the barometer is inconsiderable. It generally stands between 30° and 31°, but has been as low as 29° 7′, and as high as 31° 8′. The medium temperature of well water in Charleston is 65°, twelve degrees above that of well water in Philadelphia. By the observations of the medical society in Charleston for ten years, (from 1797 to 1807,) the average quantity of rain in a year was found to be 49.3 inches. The greatest quantity in any one of these years was 83.4 inches, and the smallest quantity was 38.6. The greatest quantity in any one month of these ten years was 12.9 inches.

The climate of South Carolina is generally regarded as unwholesome, an opinion which is neither strictly true, nor entirely false. A great proportion of the state.

particularly of the low country, is for the most part inundated; and from its sluggish rivers, stagnant swamps, ponds, and marshes, which are perpetually generating putrefaction, the seeds of febrile diseases are widely and profusely disseminated, particularly between the months of June and November. The sea shore and islands, and the ridges of land between the rivers, extending from 10 to 40, sometimes 50 miles, are for the most part salubrious. Beyond the swamps, which terminate about 120 miles from the ocean, the blessings of health are generally enjoyed, except on the margins of the rivers, and in the vicinity of ponds and mill dams. The districts of the upper country enjoy as salubrious a climate as any part of the United States.

The low country of South Carolina is infested with all the diseases which spring from a warm, moist, and unelastic atmosphere. Of these, the most frequent are fevers, from which the inhabitants of Carolina suffer more than from any, or perhaps than from all other diseases together. In their mildest aspect they appear as intermittents; in their next degree they are bilious remittents; and, in their highest degree, and under particular circumstances, they are converted into yellow fever. That dreadful distemper has made frequent ravages in Charleston. From the year 1700 to 1748, it raged at five different periods in that town, and numbers perished by its attacks. For 44 years after that period, there was no epidemic visitation of it, though it appeared in different summers in a few sporadic cases. A new æra of this fever commenced in the year 1792. It raged in Charleston in that year, and in 1794, 1795, 1796, 1797, 1799, 1800, 1801, 1802, 1804, and 1807. The number of its victims in its worst years, were, in 1799, 239; in 1800, 184; in 1802, 96; in 1804, 148; in 1807, 162; in the year 1793, 98. In 1808 it is not mentioned at all. In 1803 and 1805 it appeared slightly: in both years its victims did not exceed 69. In 1806, it is mentioned as having occurred in a very few cases under particular circumstances. In its visitations it extended from July to November, but was most ripe in August and September. With a very few exceptions, chiefly children, it fell exclusively on strangers. Unseasoned negroes were not safe from its attacks, but they escaped oftener than other strangers. When attacked, they had the disease in a slighter degree, and, with proper treatment, were more generally cured. The variable weather of Carolina often produces inflammatory affections of the throat. A disease of that organ, accompanied with the scarlet fever, frequently recurs, but is seldom fatal. Measles, influenza, hooping cough, and small-pox, are the other epidemic diseases of South Carolina. The practice of vaccination was introduced into Charleston by Dr Ramsay in 1802; and we are happy to have his authority for stating, that, among many thousands who have been inoculated, no instance has yet occurred of a clearly marked small-pox following a clearly marked case of vaccination.

The colony which sailed from England, under the auspices of the proprietors in 1669, and which was continually increased by new accessions of adventurers from the same country, was the stock from which the present population of South Carolina has sprung. On this stem, however, several foreign branches have been at various times engrafted. France, Switzerland, Holland, and Germany, have each contributed largely to the population of this country, which was long regarded as the best asylum for the oppressed and unfortunate. Of these foreign emigrants by far the largest proportion were French Protestants and German Palatines. Ireland supplied an immense number of adventurers; Scotland no inconsiderable share; and many likewise emigrated from the more northern states of America. In the course of 141 years, the population of South Carolina has increased from a handful of adventurers to 414,935 inhabitants, its population in 1810. Now, however, the new states, and territories to the southward and westward, draw to them so many of the inhabitants of South Carolina, that any casual accessions to its population are more than counterbalanced by its emigrations; so that its future population must depend chiefly on the natural increase of its own inhabitants.

A population derived from so many various sources, cannot yet be expected to present such an uniformity of manners as is necessary to establish a national character. The various groupes of emigrants, particularly from foreign countries, having settled in so many separate colonies, still retain many of those peculiarities, in manners and habits, which characterized the nations to which they originally belonged. As the connection between the different parts of the state is becoming daily more intimate, these peculiarities are gradually disappearing. The native languages and dialects of the different colonies are beginning to give place to the English; and there is even now such a similarity among the present inhabitants of Carolina, that a stranger would find it difficult to ascertain, from the language or manners of any portion of them, from what country their ancestors had emigrated. People living under the influence of the same climate, and the same government, must necessarily, indeed, acquire a strong resemblance in many of their physical and moral qualities. While there prevails among the Carolinians a diversity of character, which marks them out as the descendants of different races, there are at the same time a few general properties which they all possess, and which may therefore be regarded as the endemic qualities of the nation. Of these qualities the most pernicious are indolence, intemperance, and a propensity to contract debts; all of which have been induced either by the influence of climate, or by some peculiar circumstances in their condition.

These faults, however, are more than redeemed by several valuable qualities, though some even of these are apt to be carried to an excess that becomes culpable. A jealous regard to individual and public liberty, the surest bulwark of their civil rights and privileges, is the leading feature in the character of the Carolinians. It is only to be regretted, that the love of liberty is carried, particularly by the young Carolinians, to an excess, which seems rather to threaten the subversion of public order, than to promise security to the invaluable rights which their ancestors have purchased by their blood. So jealous are these republican sparks of what they conceive to be the natural privileges of men, that they spurn the restraints even of parental authority; and are so impatient of subordination, that many people of business choose to import from Europe clerks trained to obedience, rather than be teazed by the refractory insolence of the saucy youths of Carolina.

With this love of liberty is connected a nice sense of honour, which, though favourable in general to politeness and propriety of behaviour, is indulged to such an extreme sensibility, that the slightest breach of respect, however unintended, must be atoned for, either by a submissive apology, or by a meeting in the field. So fiery, indeed, are the Carolinians, and so jealous of their honour, that more duels are fought in Carolina, than in all the nine states north of Maryland. In Carolina, as in our own country, the duelist who kills his antagonist, may be prosecuted for murder; but there likewise, as with us, a verdict of simple manslaughter is uniformly given in by the jury, and the criminal who, by the laws of God and sober reason, is condemned as more guilty than the ordinary murderer, is received into Society without any mark of abhorrence, or even of disapprobation. Several strenuous efforts have been made in Carolina to repress this pernicious and criminal practice.

Virtues of a less stern complexion, and amiable even in their excess, form the more engaging features in the character of the Carolinians. Their hospitality to strangers and charity to the indigent and distressed, are scarcely limited, even by their pecuniary circumstances. The doors of every Carolinian are opened, not without reluctance merely, but even with eagerness, to decent travellers; and the whole state may be traversed at very little expence, by a person who, with or without letters of introduction, chooses to call at the houses of private gentlemen on his way. Among this generous people, the voice of misery is never raised in vain. Whatever can relieve the wants of poverty, or heal the pangs of distress, is administered with an unsparing bounty and affectionate sympathy, which would cover more numerous and more enormous sins than any which can be fairly laid to the charge of the Carolinians.

The prevalence of these amiable qualities may perhaps be ascribed, in no inconsiderable degree, to the influence of the ladies, whose character shines forth in Carolina with peculiar lustre. Generally well educated, their information, without fostering their vanity, enables them to maintain, with dignity and spirit, a refined and rational conversation. The politeness and elegance of their manners, imparts to all they say and do a charm, which is the more irresistible, as it seems to proceed less from art and culture, than from the native goodness of their hearts. With the vivacity and love of pleasure natural to their sex, they unite a sweetness of disposition, and a discretion, which, while they delight and animate every social circle, save the hearts of their friends from all feelings of anxiety with regard to the propriety of their behaviour. It is in the bosom of their own families, however, that their amiable qualities are most endearingly displayed. To soothe the cares and increase the comforts of a father, to administer with affectionate attention to the happiness and respectability of a brother, are the favourite occupations, from which no allurements of pleasure can withdraw a young lady of Carolina. In the discharge of their duties as wives and mothers, they are particularly assiduous and faithful; and their prudent management and kind attention, render home a most pleasing refuge from the bustle of business, and the jarring contentions in which the rougher sex are too frequently engaged.

In Carolina, the subordinations of rank which prevail in other countries, are almost unknown. Among the white people, the relation of master and servant is scarcely to be found; and the relation of master and tenant is, in the country at least, equally rare. The most obvious subdivision of its inhabitants is into planters, farmers, cottagers, and squatters. Each of these classes has a peculiar character.

The planters, who have in general large incomes, live in a luxurious and splendid style, devoting much of their time to the pursuit of pleasure, engaging in no employments which require great or continued exertions of mind or body, and possessing much of that pride and dignity of spirit, which characterises an independent country gentleman.

The virtues of the farmers are less brilliant, but more substantial, and their vices fewer than those of the planter. More dependent on their own exertions, they are consequently more active; their desires, like their incomes, are more limited; in the reverses of fortune, they exhibit greater fortitude, and have ampler internal resources to meet extraordinary emergencies.

The cottagers long continued in a state of depression Unwilling to mingle in the labours of the field with the slaves of other people, and unable to procure the situation of overseers, many of them were compelled to engage in some trivial business, which afforded them only desultory employment. Without the incitements of regular gain to stimulate their exertions, the sole end of their labours was to earn a supply of the plainest necessaries of life, which, in a country like Carolina, was so easily obtained, that much of their time remained unemployed, and all the vices which result from idleness of course disgraced their character. Of late, however, both their condition and their character have been considerably improved. The culture of cotton holds out to this class of the community strong inducements to personal industry. It enables them to work their own lands, to procure a large share of the comforts of life, and daily to acquire consequence in society.

The squatters have been at all times, and still continue, great nuisances to the public. Settling on any man's land, paying no rent, cultivating no ground, they lived by their guns ostensibly in hunting, but often in shooting down the domestic animals of their industrious neighbours. In the vast tracts of poor and unoccupied land with which Carolina abounds, these people found it easy to make temporary settlements. From these, as centres, they made their excursions, returning to them regularly with their booty and their game. In several places, the Methodists have had such influence on many of this class, as to induce them to engage in regular industry. The number of squatters has thus been considerably diminished, and of industrious cottagers or farmers increased.

Since the establishment of the federal constitution of the United States, the government of South Carolina has become somewhat complex. Acknowledging a federal legislative, executive, and judicial authority, and ceding to the union every power that is necessary to a common national government, it restricts these powers to objects of a general nature, and reserves for its own local jurisdiction the management of every thing that is purely domestic in its operation and consequences. By a convention of the people, held in 1790, the constitution of South Carolina was new modelled, so as to harmonise with the general constitution of the United States. The legislature, as in the other states, is composed of a senate of 45 members, and a house of representatives of 124 members, elected by the inhabitants of the districts which they represent. The governor is elected for the term of two years; and, after an interval of four years from the expiration of his authority, may be elected again. The governor and lieutenant-governor are nominated by the legislative body, and both at the same time. The same body nominates the judges, commissioners of the revenue, the secretary of state, the commander in chief, and the sheriffs, all of whom, except the judges, hold their offices for the term of four years. Bills cannot be passed into laws till they have been read three times on three different days in each house, and have been agreed to by both, deliberating apart. To expound these laws, and apply them to particular cases, is the duty of the judges, who, though commissioned by the legislature during good behaviour, are, immediately after their appointment, rendered independent, both of the legislature and the people. The law of England is adopted, with a few variations, as the common law of South Carolina.

For ninety-nine years after the colonization of South Carolina, no courts were held beyond the limits of Charleston, and no officer but the provost-marshal could serve a process in any part of the province. For two-thirds of that time the courts of common pleas, and of king's bench, were held by the same judge, from whose decision there lay no appeal. but to himself on a new trial.

There are now twenty-five districts, in each of which there is a circuit court, invested with complete powers, both of original and final jurisdiction. These districts are, 1. Abbeville. 2. Edgefield. 3. Newbury. 4. Laurens. 5. Pendleton. 6. Greenville. 7. Spartanburg. 8. Union. 9. York. 10. Chester. 11. Lancaster. 12. Fairfield. 13. Kershaw. 14. Chesterfield. 15. Marlborough. 16. Darlington. 17. Sumpter. 18. Marion. 19. Horry. 20. Georgetown. 21. Charleston. 22. Colletown. 23. Beaufort. 24. Barnwell. 25. Orangeburgh. For these twenty-five districts, six judges are appointed, to each of whom is granted an annual salary of 600*l*. sterling, to enable them to devote themselves to the duties of their office. In addition to the courts of common pleas and of sessions, South Carolina has always had its courts of ordinary, of admiralty, and of chancery. The two first of these courts have been held by governors or judges appointed by the proprietors, the sovereign, or the state; but since the establishment of the national government in 1789, causes in the court of admiralty, and the appointment of judges for that court, have been transferred to the United States, as appertaining to the general government. The court of chancery was likewise held by the council of the proprietors, the king, and the state, in succession, till the year 1784, when it was new-modelled, and three judges were appointed to preside over it. Since the year 1791, when it received some new modifications for the more speedy advancement of justice, it has been called the court of equity. Before the revolution, there was but one ordinary for the whole state; but since the peace of 1783, an ordinary has been appointed to each of the districts.

Under all the governments to which South Carolina has been successively subject, it was a received principle, that every subject or citizen should also be a soldier. Till lately, however, their military regulations were extremely incomplete. By some new arrangements which took place in the year 1794, the whole state is now divided into two parts, one of which comprehends five brigades, and the other four. Each brigade is divided by the commanding officer into as many regiments as the population will admit. The two majors-general who command the two divisions, the nine brigadiers under whom are placed the different brigades, and the adjutant-general, are all appointed by the legislature. The other officers are nominated by the regiments, battalions, and companies, to which they belong; but they are promoted in the order of their service.

Since the termination of the revolutionary war, annual taxes have been imposed on the inhabitants to defray the current expences of the state. Till the year 1790, the state had the income of the impost duty, and from that fund paid its civil list; but the general government of the United States has now the command of that fruitful source of revenue. The state now depends for the support of its government on taxes imposed on lands, negroes, money at interest, stock in trade, factorage, employments, faculties, and professions; and a few incidental sources of revenue, such as duties upon sales at public auction, on licenses granted to hawkers, pedlars, and theatrical performers, the interest of the paper medium loan, the interest and instalments of the debt due to the state from the United States, the dividends from its shares in the state bank, fines, forfeitures, &c. The average amount of taxes annually collected, is about 135,000 dollars; and the state receives from other sources about 175,000 dollars. The appropriations of revenue are, first, for paying the expences of the civil list, and other incidental expences of government, both of which amount, in common, to a sum between 70,000 and 80,000 dollars; and, secondly, for pay extraordinary, expences, and contingent accounts. These are so variable, that they cannot be stated with precision: on an average, they amount to about 145,000 dollars per annum. From the last report of Mr Hamilton, the comptroller of revenue, made in 1804, it appeared, that there is a balance due to the state of 754,755 dollars.

The internal resources of South Carolina are so great, and its population is so rapidly increasing, that it ranks among the first commercial states in America. Of the amount of its exports for the first fifty years after its settlement, nothing is known with certainty. There is reason to believe, that it began to export rice about the beginning of the 18th century; for Anderson states, that between the years 1720 and 1729, 264,488 barrels were exported to England, and that 429,525 barrels were exported in the course of the ten following years. About the year 1740, the trade of the province began to be considerable. It then contained about 4000 negroes; for whom, and for all other articles of importation, payment must have been in rice, naval stores, lumber, peltry, and furs. To these articles of export was added, indigo from 1747, tobacco from 1782, and cotton from 1792. The minor articles of export are, Indian corn, coco-pease, beef, pork, leather, shingles, staves, rosin, turpentine, &c. The aggregate value of exports was in a course of such rapid increase, that in the last year of the 18th century, it amounted to 10,554,842 dollars, and in the first year of the 19th century, to 14,304,045 dollars. Previous to the revolution, all the trade of South Carolina centered in Great Britain and her dependencies; with the exception of as much rice as, under a special act of parliament, was exported to the southward of Cape Finisterre. During that period the trade of Carolina was daily increasing in prosperity; and notwithstanding the many circumstances of exasperation which necessarily occurred in a country which was long the scene of civil contention, peace was no sooner restored than the commerical intercourse with Great Britain was renewed, and carried to a greater extent than it had ever reached at any former period. We cannot ascribe this to any friendly disposition on the part of Carolina, for no state of the union was more inveterate or more determined in its enmity to the country by which it had been long and peculiarly cherished. Interest is the only tie which now connects this state with Great Britain. The ingenuity of our manufacturers, the long credit which our merchants can afford to give, and the facility of making remittances to this country as the purchaser of a great portion of the native commodities of Carolina, have secured to us all the advantages which we could have derived from that state, had she continued in her former relation of provincial dependence. She has of late, indeed, been more profitable to us than she would ever have been, perhaps, in that relation; for while we are freed from the responsibility of governing, and the expence of protecting and fostering her, her exports to Great Britain far surpass their former amount, and her own politicians acknowledge, that the trade between the two countries for a single year of general peace, would now be of greater value to England than all she derived from Carolina for the first half of her colonial existence.

Few colonies have ever been established under circumstances more favourable to their literary improvement than those enjoyed by the first settlers in South Carolina. The country from which they emigrated was then in the full meridian of literary splendour; and the facilities for the diffusion of knowledge were greater than they had ever been at any previous period in the history of the world. Though in the first years of their settlement their attention must have been chiefly occupied in preparing the soil for cultivation, and providing the necessaries of life, this was no sooner accomplished than they began to adopt measures for their own literary improvement, and for bequeathing to their posterity the inestimable blessings of knowledge. So early as the year 1700, we find a law enacted, "for securing the provincial library in Charleston." Libraries were soon after formed in the different parishes, though chiefly for the use of the rectors and ministers. A free school was erected in Charleston about the year 1712; another was established at Childsbury, in St John's parish, in 1733; and a third, at Dorchester, in 1734. Besides these, several other seminaries were instituted and supported by general contribution, or by the donations and legacies of public spirited individuals. The corporations of these schools were cherished by government. They were favoured in taking up lands, which have ever since been increasing in value. They were enriched by the gifts and bequests of the charitable, and from the triple source of tuition money, public money, and private liberality, a fund was created which diffused the means of education far beyond what could have been effected by uncombined and desultory exertions.

In 1795 the citizens of Beaufort obtained a charter for the establishment of a college in their vicinity, with the privilege of such funds as they could collect from the sale of escheated and confiscated property in the district, and of vacant lots in the town of Beaufort. These funds turned out extremely valuable, and there is every reason to expect that the seminary will in time realize the warmest hopes of its founders. By far the most important literary institution in South Carolina is the state college established at Columbia, the seat of government, by an act of assembly in 1801. This college, though yet in its infancy, possesses a select and extensive library, and a philosophical apparatus, not inferior to any on the American continent. Persons of any country or of any religious denomination, if qualified by their literary or scientific attainments, are eligible to the office of professors in this seminary. The number of students at this college in 1809 was eighty-seven; and two classes had at that time graduated to the number of about forty. Students at Columbia, if not wanting to themselves, may be amply instructed in every language, art, and science, necessary to prepare them for the service of their country. Though such exertions have been made for the advancement of learning, its progress in South Carolina has not hitherto been great. In genius its natives are far from being deficient; their apprehension is quick, their imaginations lively, their enthusiasm ardent. But they are too apt to shrink from that steady persevering exertion, by which alone the candidates for literary fame can overcome the difficulties which they meet with in their progress, and securing the ground over which they have already passed, prepare themselves for farther advances and acquisitions.

For almost all our information relating to South Carolina, we are indebted to a valuable history of that state, published by Dr David Ramsay of Charleston, so late as the year 1809. Of that history, yet unknown in Europe, we procured a copy directly from Charleston, through the kindness of Mr Robert Henry of Charleston, now studying at the university of Edinburgh, who, uniting genius with invincible industry, promises one day to be an ornament to his native land. See also Chalmer's *Political Annals of the United Colonies*; Hewat's *History of South Carolina and Georgia*; Drayton's *View of South Carolina*; *Travels in North America by* Liancourt, Duke de la Rochefoucault; Morse's *American Geography*; Morse's *American Gazetteer*; Ogilby's *Geographical Account of America*; and Campbell's *History of America*. (*k*)

CAROLINE Islands. See Philippine Islands, New.

CAROLINEA, a genus of plants of the class Monadelphia, and order Polyandria. See Botany, p. 263.

CAROTID Arteries. See Anatomy.

CARPATHIAN Mountains, or Krapack Mountains, is the name of an extensive and interesting chain of mountains, which bounds Hungary on the north and east. A very full and recent account of this range will be found in our article on Hungary. In the mean time, the reader may consult Townson's *Travels in Hungary*: Demian's *Tableau Geographique et Politique des Royaumes de Hongrie, D'Esclavonie, de Croatie*, &c. Paris, 1809. (This work is translated from the German.) Esmark, *Journal des Mines*, No. 47. p. 819; Lefebre, *Id.* No. 12. p. 39; Schedius, *Journal de Hongrie*, No. III. Art. 6; Stutz, *Description des Mines de Nagyag*, Vienne, 1803, in German; Hassel *Tab. Statisq*; and Liechtenstern *Tab. Statistique*. (*e*)

CARPENTRY.[*]

CARPENTRY is the art of fashioning and framing timber for the purposes of architecture, machinery, and the like. It is distinguished from JOINERY, which considers only the fashioning and adaptation of the smaller and more curious works in wood, where the chief requisites are convenience, neatness, or elegance of form; whereas carpentry is applied to the fitting together of the greater masses, so as to combine with magnitude, strength, durability, and economy.

It is evident, therefore, that the intelligent carpenter would require an intimate acquaintance with the strength of the materials he employs; the cohesion and corpuscular force of their particles; the principles of statics and mechanics, to enable him to discover what may be the stress acting upon his work; and the mode in which strains are propagated through the different parts of his framing, that he may be thereby enabled effectually to resist them.

Carpentry, therefore, is an important department of physics. It constitutes one of the most beautiful and useful applications of the liberal sciences to the arts of life, and is a necessary part of the learning of the engineer.

The performances of the ancients in this art have none of them reached our times. But the works of modern carpenters are such as leave us little room for regret. They might many of them challenge comparison with any thing that has ever appeared in the world.

Among modern nations, the value of the art is universally acknowledged. But perhaps there was never a nation upon earth to which the *science* of carpentry was of such immense consequence as our own. Thousands of our ships, those noble specimens of art, traverse the ocean. We have risen at home to a pitch of wealth and prosperity unequalled in the history of the world. We have attained it, by the extent of our commerce, the superiority of our manufactures, and the improvement of our agriculture. And this chiefly by the wonderful multiplication of machinery, and its application to almost every description of labour. Our many great works of public utility, or private magnificence, have rendered our country the seat and theatre of art. Add to all this, that our declared enemy, by endeavouring as far as in his power to prevent our usual supplies of timber, has threatened to cut off the very sources of our prosperity. In such a nation, where the physical sciences have been successfully and diligently cultivated, which possesses many men of sufficient genius and ability, ardently desirous to promote the prosperity of their country, it were natural to think that this important science (for it well deserves the name) would have received the greatest attention, would have been prosecuted to the utmost limits of investigation, and would long ago have been arranged into a body of doctrine, founded on the extensive experience of our great masters, and illuminated by the powerful torch of mathematical and physical learning. But, strange to tell, we may search through the compass of English literature, and scarcely find a single work which professes to treat of the science of carpentry.

The books which are usually in the hands of the workman are totally destitute of any thing like principle, and content themselves with showing the method of forming the draft which is to guide the saw or the chisel. Neither the Royal Society of London, or any other of our learned societies, has ever published a single paper for the instruction of the public in these matters. Indeed, almost the only information our language can produce, is the result of the labours of a single individual, detailed in a work like our own.

A work of much merit, which appeared from the pen of a member of our national school for engineers, contains, on this subject, little more than we find delivered two centuries ago by the learned Galileo.

To look for any thing of the same nature in the flimsy productions of our itinerant lecturers, and popular books of philosophy, were to search for knowledge and learning among the school-books of children.

In the present article, we pretend not to give a complete treatise on the science of carpentry. Such an undertaking would far exceed the limits of a work like ours. But we can give a compendium of the most useful information respecting the strength of timber, and endeavour to elucidate the mode of action in some of the more simple cases, that we may from thence draw some practical maxims of construction, which may be of use to the inquisitive but inexperienced carpenter. It is matter of regret, that almost the whole of our knowledge of this useful science is due to the labours of several learned foreigners, to whose works alone we must have recourse for any thing like profound investigation. But these are, in a great measure, locked up from the access of our national artists, and they have been left by intuitive feeling, as it were, to elicit those principles, and establish those maxims, which might have been expected from the speculations of their learned countrymen. Their success has shown us, that the efforts of genius rise superior to the defects of education. Although we are very far from wishing to decry the well-earned fame of the great masters of our day, yet it is not to be doubted, that even their own confidence in their undertakings would be greater, and their success more certain, were their experience digested and regulated by scientific principles.

We should wish to call the attention of some of our learned countrymen, who have leisure and opportunity, to the prosecution of these investigations. There is a wide field for research, and their labours cannot fail of being well received in this age of improvement. It is hard that the nation, which boasts of Newton and Wren as the very founders, so to speak, of the modern mechanics, should neglect the path which originally led it to distinction among the scientific people of Europe. Our workmen are acknowledged to be the ablest, the most scientific, and intelligent, in the world. They well deserve to have their labours assisted, and their desire for information gratified by the researches of speculative men. Let the latter enter the workshop, the building yard, or the manufactory, they will find themselves in the midst of an assembly of men of science, where, ere they can pretend to communicate instruction, they will perceive that they themselves have a great deal to learn.

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[*] The Editor has been indebted for the Theoretical part of this valuable article to ALEXANDER NIMMO, Esq. F R. S. E. Civil Engineer, and for the part on Constructive Carpentry, to MR PETER NICHOLSON, Architect, whose attention has been long and successfully directed to this interesting subject.

It is to be hoped, that the late national establishment for the education of master shipwrights, will go a great way towards extending our knowledge of the science of carpentry. We were glad to see, that a superior degree of information is expected in the candidates for admission, than in those of our national establishment for engineers. This is as it should be. The nation may then expect those only to be admitted, who evince at least some ability for the office, and some aptitude for instruction; and who will acquire under its care that superior knowledge which may qualify them for directing the labours of artists, confessedly the first in the world, instead of issuing from the seminary with no more learning or experience than what might have been equally well obtained at any country school.

We propose to divide the present article into two parts; the first containing the Theory of Carpentry, and the second Constructive Carpentry.

PART I. THEORY OF CARPENTRY.

The science of carpentry depends on two principles: The strength of the timber employed, and the strains to which it is exposed.

The strains to which timber is exposed are various. They are simple, when the energy of the straining force acts directly in overcoming the cohesion of the particles; or they are compound, when it acts by the intervention of a lever, or other mechanical power.

The simple strains are,

1. The piece may be pulled or drawn in length, as in the case of a kingpost, the upright rod of a pump, or the like; it is then usually named a tie.
2. It may be compressed in length, as a post or strut.
3. It may be strained laterally or crosswise, as when a tenon breaks off, or a rafter fails at the wall.

The piece of timber is also exposed to similar strains, acting on the softer connecting matter, instead of the woody fibre. It may be split or torn asunder; it may be compressed or squeezed as a wedge or tree nail; or it may be pushed out in the direction of the fibre, as sometimes happens in the heel of a mortice.

The compound strains of most importance are,

4. The piece may be strained directly across, as a joist or lintel; or obliquely, like a rafter.
5. It may be twisted, as in the axles of mills, ship-rudders, and screws.
6. It may be bended or crooked, and then subjected to any of these strains, or to several of them together.

I. *Of the Resistance to Distension in Length.*

Substances, of which the texture is uniform, such as metal, glass, stone, or the like, resist a strain which tends to pull them directly asunder, by the simple force of cohesion among their particles; and supposing the force of every particle to be the same, the total amount will be as the number of particles, that is, as the area of the section. But should the body be of a fibrous texture, as timber or cordage, the disruption may take place, not only by the snapping of each individual fibre, but also by their separation, owing to one parcel being torn from among the others with which it is joined. The resistance to the fracture in that case will be produced by the friction of one fibre against another, increased in the case of ropes by twisting, and in the case of timber by the softer connecting matter intermingled with the ligneous fibres.

Should we suppose, with Galileo, that the fibres give way all at the same instant, then it is perfectly evident, that the direct or absolute force must be proportional to the area of the section. But it is doubtful how far we can depend upon that principle, even in this simple case; for it was long ago observed by Leibnitz, Mariotte, &c. that there was no matter how hard soever, were it glass itself, but would undergo some extension before absolute rupture. There is little doubt, but this property may have some effect, even in the case of simple distension. It certainly produces important modifications in every other case. The fibres, in extending, may compress each other, at least, unless they are perfectly parallel and longitudinal—a rare, and indeed only a theoretical case; while, even there, each fibre, by the diminution of diameter, gets loose, and is deprived of the benefit of lateral friction; so that, by snapping at their weakest parts and tearing out, they may afford us a surface of fracture, having any given ratio to the transverse section. But at present, perhaps, it will be more useful to the practical carpenter, to defer our inquiries into this department of our subject; we shall find another opportunity of resuming them. This is a subject on which theory can afford us little real information; the absolute strength must be left for the object of actual and judicious experiment.

The inquiries which have been instituted for the discovery of the strength of timber by means of experiment, are by no means so numerous as could be wished; neither have they always been conducted with due attention to those numerous precautions, and exact historical description, which are absolutely necessary to render them useful. Hence, there are in almost all of them great and anomalous differences. Many experiments have, indeed, been made on the transverse strength; perhaps the most magnificent are those of Buffon, recorded in the *Ann. Paris Acad.* 1741 and 1742. Duhamel has given a great many in his *Traité sur le Conservation de Bois;* but they have omitted that primary and most essential object of their inquiry, the direct and absolute strength of the timber employed, by which it resists extension and compression. Experiments made on the transverse strength are so much modified by the different degrees with which timber resists those strains, that little satisfactory reasoning can be founded on them, however numerous they may be, or however carefully performed and faithfully described.

Muschenbrock is almost the only author who has enabled us to judge of the accuracy of his experiments; he details those on the ash and the walnut, stating the weights requisite to tear asunder slips taken from the four sides of the tree, and on each side, in a regular progression from the centre to the circumference; and he says all the others were made with equal care. We cannot, therefore, see any reason for distrusting the results. Yet they are considerably higher than most other writers have given. The probability is, that they were made in such small specimens, that any want of soundness, which would of course be easily detected, induced him to reject the example, although absolutely requisite to give a fair average. Perhaps, too, he gives us the utmost load which may be borne—rather that which will break the bar in a few seconds. This is much more than can be safely trusted to the beam.

In the English language, we have hardly any thing to guide us. The Royal Society appear, at an early period, to have paid some attention to the subject; but they have recorded nothing.—Emerson gives a list said to be derived from experiment; but we are not even told, whether it refers to the transverse or the longitudinal strength of the material. To these we shall add some related by the late Dr Anderson of Glasgow, a man fond of experiments, and probably faithful in relating them.

Absolute strength of an inch square drawn in length,

	by Muschenbroek. lbs.	Emerson. lbs.	Anderson. lbs.
Locust tree . .	20,100		
Jujeb	18,500		
Beech	17,300	6,070	6,300
Oak	17,300	7,850	6,114
Orange . . .	15,500		
Alder	13,900	4,290	5,094
Elen	13,200	6,070	4,455
Mulberry . . .	12,500		
Willow . . .	12,500	4,290	
Ash	12,000	6,070	6,300
Plum	11,800	7,850	
Elder	10,000	5,000	
Pomegranate .	9,750		
Lemon . . .	9,250		
Tamarind . .	8,750		
Fir	8,330	5,000	2,928
Walnut . . .	8,130	5,360	
Pitch pine . .	7,650		
Quince . . .	6,750		
Cypress . . .	6,000		
Poplar . . .	5,500		
Cedar	4,880		
Box		7,850	
Yew		7,850	
Holly		5,000	
Crab		5,000	
Cherry		4,760	
Hazle		4,760	
Asp		4,290	
Birch		4,290	

According to Emerson, a cylindric rod of good clean fir, an inch in circumference, drawn in length, bears 400 lbs., and a spear of fir, two inches diameter, bears 7 tons, but no more; a rod of good iron, one inch in circumference, bears nearly 3 tons weight, and a hempen rope of one inch in circumference carries 1000 lbs.

He also gives the following rule: Square the diameter expressed in inches, and multiply for

Fir, by $8\frac{4}{5}$
Rope, by 22
Iron, by 106

The result gives the load in cwts., which may be safely trusted.

It is to be observed, that all these results are derived by proportion from the strength of very small specimens; and this may account for such great anomalies. It is highly probable, that the cohesion of timber, especially that of which the fibres are much intertwisted, such as oak, increases in the thicker pieces in a ratio which is greater than that of the area of the section. Such fibrous bodies, by being drawn in length, are strongly compressed together, and those weaker fibres are more firmly retained, which, by breaking at their finest part, might otherwise tear out.

This is indeed always the way in which such bodies fail, viz. by the fibres sliding out from among each other, and not by an absolute snap. In this respect, therefore, timber may be compared to cordage; and there we have several examples of the truth of this principle.

Duhamel mentions, that a 6 thread rope bore 631 lbs., but that thicker cords bore more in proportion. We have arranged the results below.

No. of threads.	Weight borne in lbs.	Weight which is as area of section	Excess of fact above theory.	Ratio of excess.
6	631	631	. . .	. . . .
9	1014	946	68	1.072
12	1564	1262	302	1.238
18	2148	1893	255	1.135

Though the increase in these experiments be not regular, yet it may be sufficient to convince us, that the larger cords, and consequently the larger timber, otherwise equally sound, will be in proportion stronger. But, as in great works, there are numberless, and often imperceptible defects of solidity, it will be safest not only to disregard the additional strength arising in this way, but also, even in this simplest kind of strain, never to load the piece of timber above one-half, or even one-third, of what the first proportions would suppose it equal to bear.

II. *Of the Resistance to Compression in Length.*

Timber, when so placed, that the strain tends to compress the piece lengthwise, is perhaps in the most favourable position for taking advantage of its strength. We can be absolutely certain, that the whole of the fibres are called into action, and we may, by forming the joint exactly at right angles to the strain, be ensured of the uniform action of each. When drawn in length, on the other hand, it frequently happens, that bolts, mortices, or joggles, are the only way in which we have a hold of the beam; and, that so far from having the strength of the whole transverse section to depend on, we have only the lateral cohesion and friction of those fibres, which form the heel of the mortice, or shoulder of the joggle. While, therefore, long heels and joggles, deep scarfing, or stout bolts and straps, are the chief objects to be attended to in the one case, the same difficulties do not occur in the other, and we have not the same chance of failure from defective workmanship. We have, therefore, much hesitation in admitting the maxim of an author, to whom this department of engineering is greatly indebted, that *ties are in general better than struts*. It is true indeed, as he *says*, that a small iron rod will support a load as a tie, which could not resist a moment were it compressed by a similar strain. But this does not arise from the mere circumstance of its acting as a tie; for the strength of cohesion must be pretty much the same either way; it is only from the chance of bending, and becoming thereby subjected to powerful cross strains, where the small diameter of the iron rod enables the distant strain to act by the energy of a powerful lever. When bending is altogether prevented, as in the case of an iron truss inclosed between the two halves of a girder, we know that the resistance to compression may be safely relied on. And, when with the same area of section, the power of leverage is diminished, as by shortening the length of the strut, or by increasing its diameter, as by deep flanging, or forming the rod into a hollow tube, we know the resistance to compression is at least as powerful as in any form of a tie.

In investigating, therefore, the resistance to compression, and especially in endeavouring to obviate those unavoidable weaknesses which this position involves, we must attend carefully to the mode in which the strain is propagated through the parts of the beam. We would recommend to the inquisitive reader, to study what we have said in the article Boscovich's Theory, on the mutual action of points of matter: he will find it greatly facilitate his acquiring correct notions of this subject. We shall hereafter have occasion to refer more particularly to that article; but, in the mean time, we would wish to give the intelligent practitioner some simple ideas of this matter, which may possibly tend to assist and direct his practice. It is to be regretted, that the experiments on the strength of timber against compression, are still fewer than those which refer to the first mentioned strain, although they are certainly of equal importance.

When we press a rod of soft clay or wax endwise, it bulges out in the middle; a beam of wood cripples, swells out in the middle, the fibres lose their cohesion, rents appear, and it speedily yields to the strain.

Take a bundle of small rods, or even rushes, set them on end loosely and compress them, they will separate from each other in the middle, bulge out, and speedily give way; bind them firmly at two or three places, their strength is greatly increased; wrap them up entirely from end to end, they are stronger still: the resistance, therefore, to compression, depends intimately on the lateral adhesion. Separate the whole into several smaller parcels, of which, while some are firmly wrapped up, let others be held more loosely; place the loose parcels on one side, and repeat the compression, the looser part will yield, the others following will be bent, and may snap with a much smaller force than they would have resisted alone, because the bending enables the strain to act with the energy of a powerful lever. The exterior fibre, which is most bent and strained, gives way first, ere the strength of the others can be acted on.

It is evident that the fibres, which are twisted, must resist compression much less than those which are straight. And accordingly, if the experiments of Muschenbrock are to be relied on, oak will hang more than twice as much as fir, yet the latter will support nearly three times as much as the former.

The resistance to compression, therefore, depends greatly on the power by which bending is prevented, either in the individual fibre, or in the entire piece. Now suppose that a bar of an inch square can support a given quantity M as a ton, (Plate CXII. Fig. 1.) then it is evident, that before we produce the same strain in the fibres of a bar of two inches, we must at least lay on four tons N. But, in truth, we may lay on a great deal more; for, supposing this smaller beam has been bent a little, until the fibres on the weaker side were just as much compressed, and those on the stronger just as much dilated, as could be done with safety, then we may say, that there is some intermediate place, which, having neither suffered dilatation nor compression, may be considered as the fulcrum or centre of conversion about which this motion has taken place. Let this be the point A, or *a*, it is evident, that the distance of the exterior, or any other resisting fibre from the centre A, will be to the distance of every similar fibre from *a*, as the diameter BC to *b c*. The fibres of the large bar, therefore, in so far as bending is concerned, are not in the same situation with those of the smaller, and before they arrive at it, the weight N must be farther increased in the ratio of the diameters of the bars; that is, N must be to M in the ratio of the cubes of BC and *b c*. Indeed there is reason to believe, from the experiments of Muschenbrock, and the investigations of Euler, that the resistance to compression increases in a still higher degree than this, perhaps in the ratio of the fourth powers of the diameters, at least for those of which the fibres are ridged, as fir, &c. and which were found by Muschenbrock far better adapted to this purpose than the oak, and others of which the fibres are twisted.

The relative strengths are by him for a bar 4 feet long, $\frac{7}{10}$ inch square.

	lbs.
Fir	226
Linden	206
Beech	146
Oak	86

which are very different from the order in which these woods resist being drawn in length.

Oak has borne a pressure of 4000 lbs. per square inch. Six of the pieces of oak in Girard's experiments, broke with 2710 lbs. pressure per square inch; but 15 others bore much more. A great deal depends on the length and uniform soundness of the pieces.

Perronet gives the following proportions from experiment:

Oak	$12\frac{1}{3}$
Willow	$9\frac{3}{5}$
Fir	$9\frac{2}{15}$
Poplar	$7\frac{2}{5}$
Ash	$7\frac{1}{5}$
Elm	7

His experiments were made on short specimens.

Muschenbrock says, the relative strength of pieces of wood against compression, is as the cube of their diameter directly and inversely as the square of the length. This is after some investigations of Euler. They are founded upon principles that are somewhat dubious. He merely assumes a certain value for what he calls the rigour of the beam or post, without much inquiry as to the way in which that rigour is effected.

The resistance increases much faster than the area of the section; and in so far as the failure arises from bending, this observation becomes of the utmost importance. We can frequently confine the bending to one direction only, in which, by placing the greater dimension, we will vastly strengthen the post without increasing the scantling. This principle has been forced upon the attention of the carpenter in the case of cross strains; and joists and rafters have gradually become thinner and deeper. But we doubt whether the majority of carpenters have even thought whether a square upright, in a partition of 6 inches, or one of 4 inches by 9, is the best. Yet the latter will be trussed sidewise in the building, and its resistance to bending in the direction of its breadth, is at least three times as great as the other.

We shall have occasion to resume this subject. Our investigations respecting it can be pursued with much more facility, when we comprehend the principles of the transverse strength of timber.

Experiments on this kind of strain should be multiplied. It is that against which we must guard in the most difficult and delicate cases which come under the consideration of the engineer. But such experiments must be entrusted to men of science; for we see that the modifications arising from bending, &c. are so great, that a set of them made in the form most likely to be adopted, would be so completely anomalous, as to afford no rule of practice whatever. We must attend particularly to the manner in which the fracture is produced; we must endeavour to discover the means of opposing it. Thus we know, that friable matter, as stone, cracks obliquely under pressure, and the pieces slide along the surface of fracture; that fibrous matter, as wood, splits longitudinally, and bulges out. Now, both of these may be prevented by hooping, and that even loosely. On the other hand, should the interior fibres of the timber yield, by penetrating through the softer parts, we may condense the whole, by driving the hoops tight along a very gentle taper. By this means, again, we diminish the diameter of the strained part, and, consequently, expose it more to the risk of bending. This last may be obviated by thin flanges, cross bridles, and trusses. An increase of the diameter acts both as a hoop against bulging out, and as a truss against bending.

If, by these several or by similar precautions, we can reduce the strain to an absolute crush, there is no question but we shall have resistances vastly greater than what have been usually experienced, and to which, in truth, it is difficult to perceive any limit. The science of carpentry consists, indeed, entirely in the reduction of all strains to this one; and, after all, we do not yet know in what situation this resistance acts most favourably. There is a most extensive field here for research, but all that can be done by an individual is to regret, that while so little progress has been made in forwarding this enquiry, the necessary experiments are beyond the means of a private person. We shall at present, therefore, take it for granted, that the resistance to compression among the particles, is much the same as that against distension. It is highly probable, that this is the case just at the beginning of the strain. And although this principle, when applied to practice, becomes liable to great modifications—for the strength increases rapidly with an increased diameter, while it diminishes greatly by increasing the length—yet we shall perceive the reason of these modifications much more distinctly, as we proceed in our investigations respecting other strains.

III. *Of the Lateral Resistance.*

The piece may be crushed across, as when a pin or a tenon fails, or a joist gives way at the wall, where we have the strength of one section to overcome; or when a piece is torn out crosswise by a square edged tool; in which case we have the united strength of the two sections. Some experiments were made by the late Dr Robison, with a view to determine the resistance to this strain.

Two iron bars were disposed horizontally, at an inch distance; a third hung perpendicularly between them, being supported by a pin made of the substance to be examined. This pin was made of a prismatic form, so as to fit exactly in the holes in the three bars, which were made very exact, and of the same size and shape. A scale was suspended at the lower end of the perpendicular bar, and loaded till it tore out that part of the pin which filled the middle hole. This weight was evidently the measure of the lateral cohesion of two sections. The side bars were made to grasp the middle bar pretty strongly between them, that there might be no distance interposed between the opposite pressures. This would have combined the energy of a lever with the purely transverse pressure. For the same reason, it was necessary that the internal parts of the holes should be no smaller than the edges. Great irregularities occurred in the first experiments from this cause, because the pins were somewhat tighter within than at the edges; but when this was corrected, they were extremely regular. He employed three sets of holes, viz. a circle, a square, (which was occasionally made a rectangle whose length was twice its breadth,) and an equilateral triangle. In all these experiments, the strength appeared exactly proportional to the area of the section, and quite independent of its figure or position: but it was considerably above the direct cohesion; that is, it took considerably more than twice the force to tear out this middle piece, than to tear the pin asunder by a direct pull. A piece of fine freestone required 205 pounds to pull it directly asunder, and 575 to break it in this way. The difference was very constant in any one substance, but varied from $\frac{4}{3}$ds to $\frac{6}{3}$ds in different kinds of matter, being smallest in bodies of a fibrous texture. But indeed he could not make the trial on any bodies of considerable cohesion, because they required such forces as his apparatus could not support. Chalk, clay baked in the sun, baked sugar, brick, and free-stone, were the strongest that he could examine.

We conceive that a good reason may be given why the resistance to the strain should be greater than the direct cohesion. The exterior line of particles is supported by those behind. Before any remarkable shift in the place of the exterior line takes place, the cohesion of the whole section may be called into action. This will certainly be the case with the granular and less compressible kinds of matter. But this is not all. The lateral motion of the first particle will, to a certain degree, be communicated to that adjoining and within it; this will, in its turn, exert a similar resistance, and communicate the force still farther. The pressure, therefore, is not confined to the area of section, but is propagated into the body of the beam; it not only forces each particle to slide along its neighbour, squeezing and crushing those which are in the neighbourhood of the section of fracture, but likewise tearing them away from those on the side opposite to the pressure. Fibrous matter, such as timber, must especially act in this way. We cannot expect the fibres to snap and fly at once, unless where the motion is exceedingly rapid, as in the penetration of cannon-shot. The fibre will yield gradually, and bend. The bending will be propagated into the beam, to a distance which we cannot well tell, but which seems proportional to the tenacity of the fibre. At length, it will yield much in the same way as it does to a direct pull; which accounts for the smaller excess of strength found in fibrous bodies.

This case is, therefore, by no means so simple as may appear. Although there be reason to believe that the strength is proportional to the surface of the section, we should think it advisable that the bearing surface should be as wide and flat as possible, for all matter is compressible, and wood, especially, is most so across the fibre. Should the part, therefore, which first receives the strain be narrow or thin, it is possible that the front fibres may be crippled or give way, ere those intended to support them can well be brought into action. This principle should always be kept in view in the formation of tenons and mortices, or joints of a similar kind, and appears well known to the intelligent carpenter. The same thing is frequently aimed at, by making the tenon long, and giving it a deep hold in the mortice. Such a practice gives no additional strength whatever; it is even injurious. For if the tenon bear upon the interior part of the mortice instead of the outer edge, the strain comes to act upon it with the energy of a lever, and may thus be increased in any degree. The bearing side of the tenon being no longer than sufficient to give a firm hold, the end may be bevelled above, till flush with the upper side of the beam. We may trust to every square inch of the section of such a tenon the weight stated under the first head; for though experiments shew it to bear more, it is as well that this excess of strength should not be depended on.

What we have now stated may throw some light upon the resistance which a wedge or tree nail affords to compression. It is obvious that this must chiefly depend on the structure of the timber; and we have hardly any experiments worthy of memory upon the subject.

Respecting the resistance to splitting, and that which hinders a piece of straight-grained timber from sliding out in the direction of the fibre, we are equally at a loss for information. The strength is, without doubt, proportional to the surface of fracture, but we cannot state its amount. Strait fibred timber is very weak in this way, and the reason is obvious; it is the cohesion of the soft connecting matter, and not of the woody fibre, that we have to resist the strain.

Emerson has said, that tough wood, such as elm or ash, across the grain, is from seven to eight, or even ten times weaker than when strained in the direction of the fibre. These woods may be supposed, therefore, to resist a force tending to split them, or to tear out the heel of a mortice with about 700 lbs. on the square inch of the surface of fracture. But he says, that the wood of straight fibre which easily splits, such as *fir*, is 16, 18, or 20 times weaker than in the length of the fibres. Their resistance will, in that case, be from 250 to 300 lbs. per square inch of section.

We have now considered those strains in which the cohesion of the timber is directly opposed to the straining force. We have sound reason to regret, that the paucity of the experiments hitherto made on the direct cohesion, has prevented us from giving such satisfactory information respecting the corresponding strength as might be wished. We regret this the more, as it is to some one of these simple kinds that the carpenter should endeavour to reduce every other: he is then sure of benefiting by the cohesive strength of his materials. In the others, or compound strains, he has not the same advantage.

Of the Compound Strains.

The variety of compound strains is inexhaustible; we can only be expected here to treat of the simplest and most important.

IV. *Of the Resistance to Cross Strains.*

The usual form of this strain is when the points of bearing are at some distance from each other, and the load is somewhere applied between them. This case has attracted the attention of many writers, and has been made the subject of numerous experiments. The benefit derived from these experiments, however, has not been so great as might have been expected; and we are yet very far from being able, with precision, to determine the strength of timber against a cross strain.

The first who attempted to give any theory for the transverse strength of timber was the celebrated Galileo. He supposes the prismatic body, ABCD, (Plate CXII. Fig 2.) is fixed at one end into a wall, from which it projects horizontally, and is acted on by the weight W, hanging from the farther end. Let the body be supposed to break across in any line EF. In the instant of fracture, the surface EF is supposed to exert every where an equal cohesion. As the section across is, therefore, every where the same, it is evident that the energy of the weight W will increase with the length of the lever CF, and of course the greatest strain will be just at the wall, and in the line DA. The action at the point C tends to make the body ABCD turn round the point D as round a centre; and therefore the parts at AH must separate from each other in the horizontal direction. If we suppose all the particles in the section AD to be exerting an equal force, and that the disruption takes place at once, then the total force may be supposed accumulated in the centre of magnitude or gravity G; and the energy of the weight W, at the instant of fracture, will be to the absolute strength of the beam in resisting a direct pull, as the distance of the centre G from D, to the length DC.

Now if the beam be rectangular, the centre of magnitude G will be in the middle of its height or depth AD; wherefore we should have for the strength of the beam as the length of the bearer to half its depth, so the absolute cohesion in length to the transverse strength.

It will be improper for us to pursue this view of the subject any farther. It has led to very erroneous conclusions: and, from being all that is to be found in our common treatises, has become, in them, the foundation of very false maxims of practice.

Succeeding writers, such as Mariotte, Leibnitz, &c. have perceived that this supposition of equal cohesion, exerted by all the particles in the instant of fracture, was not conformable to the proceeding of nature. We know that there is no body, however hard, but is somewhat extended before breaking. When a force is applied across the beam at C, the beam is bent downwards, becoming convex on the upper side. That side is therefore on the stretch, and the particles at AH being farther removed from each other, are exerting greater cohesive forces. We know that these greater forces are, while the body is not crippled, proportional to the extensions. Suppose, then, the beam to be so much bended, that the particles at AH are just giving way; it is plain that a total fracture must immediately ensue, for the force which exceeds the whole cohesion of the particle at A, and a certain portion of the cohesion of the rest, will still more exceed the cohesion of the particle next within A, and a smaller portion of the cohesion of the rest. Now, since the force of any fibre is as its distance from the fulcrum D, in order to find the amount of the whole, take DM$=x$, DA$=a$, and the greatest force of the exterior fibre AH$=f$, then the force of any fibre MN, being (DA : DM :: $a : x :: f :$)$\frac{xf}{a}$, and from the usual fluxionary notation, the force of a fibre $\dot{x}$ will be $\frac{f\,x\,\dot{x}}{a}$, this resists the strain by the leverage MD$=x$. Its energy therefore is $\frac{f\,x^2\,\dot{x}}{a}$, and that of the whole section, or $\int\frac{x^2\,\dot{x}}{a}$ is $\frac{f}{a}\times\frac{1}{3}x^3$, which when $x=a$ is $\frac{1}{3}fa^2$. Now fa is the force of absolute cohesion, and therefore the force resisting the transverse strain is the same as if the whole absolute cohesion were accumulated in a point G at one-third of AD from D.

This hypothesis assigns a smaller relative strength to the beam than the hypothesis of Galileo. In that, the section is supposed to have an energy equal to half the absolute strength of the rectangular beam. In this it is found to be only one-third.

But ere we proceed to draw any conclusions from what we have now stated, it will be proper to observe, that even this supposition does not fully explain the mechanism of the transverse strain. The force bending the body ABCD, not only stretches the fibres on the convex side of the beam, but compresses the lower or concave side. There must be some material support as a fulcrum for the lever when it stretches the fibres or tears them asunder, and this can be found in no other way than from those particles which are thus compressed. Let CDG (Plate CXII. Fig. 2.) be considered as a bent lever, having the fulcrum DE, by means of which the weight W, and cohesion of the surface AD, are in equilibrio. We know that the pressure on D will be the same as if the other pressures were both applied to that point, each in its proper direction. The pressure at G is to that at C, as DC to DG. Completing, therefore, the parallelogram GC, and drawing the diagonal KD, it will express the direction and magnitude of the equivalent pressure on the fulcrum D. This pressure is opposed, by the resistance to compression of the particles towards D, which may be expressed by DC; and, again, by the cohesion of the particles in the line of section DA, which of course is expressed by DG. The particle D is not only pushed backward, but drawn downward. This last observation is easily verified. Take a stick of soft wax and bend it gently, the lower or concave side will be observed to swell out, and the convex side to get flat, before it cracks and gives way. Take a parcel of the leaves of this book, and holding them firmly together at two parts of the edge so as to give them adhesion, attend to the effects of bending them, the leaves in the hollow side will bulge out and separate, those on the opposite side become flat and clap closely together. Attend now to the cracks and fissures, that is, the openings which are to be seen among the leaves; they afford much room for observation, and will be found to give good notions of the effect of the transverse strain; the parcel may be bent so much, that every leaf will separate to the very last, which therefore is the only one that resists the folding by its cohesion. The open part of the rest shows us the form of the splinter IRS, (Plate CXII. Fig 3.) which would fly off, were not the matter so coherent. It is somewhat triangular, and the direction of its sides appears to be much the same with KD, and its correspondent on the opposite side. Slacken the parcel on one side, and pinching again, observe the slide which has taken place among the leaves. Thus the cohesion of the ligneous beds has an important effect in the transverse strength of beams. And, of balks cut out of the same tree in different ways, that in which the layers are placed on edge, will always bear much more than that in which they lie on their sides. This cohesion is not only useful in preventing slipping, but also in preventing the fibres on the concave side from parting too easily from the rest. This consideration is of importance, especially in the building up of girders, and the formation of masts. It shows that we must not be too hasty in saying, that fir should always be chosen for the sides made hollow by the strain, in preference to oak, merely because it is stronger as a pillar, though oak be tougher as a tie. There are other circumstances to be thought of. The fibres of fir have little lateral cohesion; and unless we can secure them, and contrive to bring them all into action, we may be led into serious mistakes. But let us now examine the mathematical consequences which this last supposition involves. Let ARSB, Fig. 4, be the vertical section of a beam so constituted, that when the beam is loaded at one end with the weight W, the fibres in CR are in a state of compression; while those in CA are in a state of extension, that in the instant of fracture any particle in CA, as E, adheres by the force E *e*, and one in CR, as F, resists or repels with the force F *f*. The force of each particle being expressed in this way, some line *a* D *r*, limits the whole of these ordinates, and the area *a* D A, expresses the total force of adhesion, while D R *r* expresses the force of repulsion. Should the force of each particle be proportional to the extension or compression, which is highly probable, at least for the safer strains, then *a* D and D *r* will be straight lines; and if the resistance to compression be exactly equal to the resistance to a similar extension, *a* D *r* will be one straight line. But this is not to be expected; for in most bodies which are tolerably firm, the resistance to compression is likely to be the most considerable; and therefore the ordinates E *e* are likely to be smaller than F *f*. But since the weight W is understood to act perpendicularly to the length of the beam, the adhesion and repulsion in the section of fracture must be equal, and therefore the area of A D *a* equal to the area D R *r*. Now we have said, that in firm bodies, for the most part, the ordinates E *e* are smaller than F *f*, the perpendicular AD must therefore be longer than DR, and the neutral point D nearer the lower side of the beam.

In soft and compressible bodies, RD may equal or even exceed AD. The experiments of Duhamel show this to be remarkably the case in willow, and even in pine. He took 24 pieces of young willow, nearly of the same size, and formed them into bars of 3 feet long, $1\frac{1}{2}$ inch square, taking care to have the heart of the tree in the centre; supporting these by props $\frac{3}{4}$ths of an inch from each end, he broke them by weights hung on at the middle.

The mean weight borne by six entire bars was $524\frac{5}{6}$ lbs.

He next cut two of the bars one-third through with the saw, and filled up the draft with a wedge of dry oak. The mean of these was 551 lbs.

He cut two others one half through, and wedged up the cut as before; and although one of them broke short on account of a concealed knot on the lower side, yet the mean of weight borne by these was 542 lbs.

He cut another set of six bars, three quarters through in the same way, and the mean weight borne was $530\frac{2}{3}$ lbs.

It is worthy of remark, that one of these last, when loaded with 435 lbs. was unloaded, and a thicker wedge put in place of the first slip of oak, it then broke only with 576 lbs. Had it been successively supplied with thicker wedges, it might possibly have carried a great deal more.

From these experiments, it is evident that more than two-thirds of the thickness, or perhaps three-fourths of it, does not contribute by its tension to the strength of the original bar. The compressibility of this kind of timber, appears much greater than its dilatability, and some other experiments of Duhamel seem to confirm this.

He has also given us some experiments on Baltic fir. The battens he employed were three feet long, fifteen lines thick, and seven broad.

Two such bars, when entire, bore 144 lbs. 9 oz. at a medium; three bars sawn one-third through in four places, and the cuts fitted with slips of hard wood, bore 132 lbs. 2 oz.

Two others, cut half way through in four places, bore 146 lbs. $7\frac{1}{4}$ oz.

Two others, cut two-thirds through in four places, bore 136 lbs. $15\frac{1}{4}$ oz.

One bar had a cut made on one side of a foot long, and half an inch deep, the space filled with a piece of oak, it bore 509 lbs.

Another, when the cut was only one-fourth of an inch deep, bore 551 lbs.

An entire bar, of equal dimensions, bore 576 lbs. nearly.

Observe that the oak is more compressible than the fir.

The point D being the centre of fracture, the centre of effort of the attractive forces will be found as in the last hypothesis. Let this be E, if the beam AS be a rectangular prism, the distance DE is one-third of DA. In like manner, the centre of the repulsive forces F will be similarly situated with respect to the line AR. The distance between these two points will be the shorter arm of the lever, by the energy of which, the force of attraction resists the effort of the weight W, while the centre of repulsions serves as the fulcrum; or if we choose to consider it so, by which the repulsions oppose the effort of W, the centre of compressions acting as a fulcrum.

If we suppose the extension in the instant of fracture to be equal to the compression, then the distances of the centres of effort from the neutral point D are equal, and the sum of them, or length of that arm of the lever by which the cohesion acts, is equal to one-third of the whole depth.

The point D, therefore, becomes the virtual fulcrum of the lever, by which the forces of attraction and repulsion in the section AR resist fracture: the action of the part above D is precisely the same as in the last hypothesis; and in a rectangular beam, upon the supposition of the force increasing as the extension, the centre of effort E will be at one-third the distance DA from D. But in addition to this, the resistance to compression in the part DR acts precisely in the same way, and its effect may be supposed condensed in the centre F at one third of DR from D; the whole resisting energy will therefore be the absolute cohesion of DA drawn into one third DA, and added to the force of repulsion in DR drawn into one-third DR. If we suppose the forces of adhesion and repulsion to be equal, DR and DA will be equal, and taking, as before, a the whole depth, f the force of a fibre, whether against compression or dilatation, the energy of the section will be $\frac{1}{6} a \times \frac{1}{2} a f + \frac{1}{6} a \times a f = \frac{1}{6} a^2 f$, that is, the whole absolute strength may be conceived to act at the distance of one-sixth of the depth of the beam from the fulcrum; or the absolute strength is to the resistance to cross strain as the length of the beam to one-sixth of its depth.

We have found, then, that the principle of compression makes an important change in our views of the strength of timber. It shows the transverse strength to be only one-half of what the supposition of Mariotte, and only one-third of what the hypothesis of Galileo had made it. The difference might be still greater, were the body much more contractible than expansible. For in that case, the quantity of fibres in a state of expansion being smaller, would not only have less force in themselves, but would act with a shorter arm of the lever. Thus, in the same figure as before, suppose $DA = \frac{1}{3} AR$, and we have $DE = \frac{1}{9} AR$, the resistance of the upper or dilated part would be $\frac{1}{3} a f \times \frac{1}{9} a$, and the resistance of the lower part being the same, the whole is $\frac{2}{27} a^2 f$, or nearly $\frac{2}{9}$ of the strength which Mariotte's supposition would give.

Observe, that although a body may, by the facility of extension, be readily bent or broken, though not very compressible, yet in this respect the other two theories would not be found so very erroneous, as it is the resistance to extension alone which they have considered.

It would be of vast service in calculating the strength of timber, if we could distinguish, even with tolerable correctness, the amount of the fibres under compression from those which were in a state of dilatation; or, what would be much the same, could we learn what proportion there is between the compressibility and extensibility of the timber. But this is matter of fact, and not to be looked for as the result of any theory. The strain now under consideration seems the best calculated for prosecuting this research. Thus, if we find that a piece of fir timber, an inch square, requires 9000 lbs. to pull it directly asunder, and that 150 lbs. will break it transversely, by acting ten inches from the section of fracture, we may conclude that the neutral point is in the middle of the depth, and that the attractive and repulsive forces are equal.

We should imagine that the sensible compressions in fibrous bodies, as timber, are likely to be much greater than the real corpuscular extensions. An undulated fibre can only be drawn strait, and then corpuscular extension begins; but it may be bent up and coiled to an indefinite degree, without altering much the situation of its particles, and of course without affecting sensibly the corpuscular compression.

We might pursue this enquiry to a great extent, but it is rather foreign to our present object; we shall find some other opportunity of returning to it; and, in the mean time, hasten to draw practical inferences from what we have stated.

It is worthy of remark, that in all the hypotheses for expressing the resistance to fracture, the strength of the beam is as the breadth and square of the depth directly, and length inversely; the only difference among them being in the value of the constant numerical coefficient.

The strength, therefore, of a beam depends chiefly on its depth, or rather on that dimension which is in the direction of the strain, and this is confirmed by constant experience. The strongest joist which can be cut out of a round log, is not that which contains the greatest quantity of timber, but that which has the breadth into the square of its depth the greatest possible. Take AC the diameter of the log $= a$, Plate CXII. Fig. 5, the breadth of the joist DC $= x$, its depth DA will be $= \sqrt{\text{AC}^2 - \text{DC}^2} = \sqrt{a^2 - x^2}$, and the product $\text{AD}^2 \times \text{DC}$, that is $x(a^2 - x^2)$ must be a maximum, and therefore its fluxion $a^2 x - 3x^2 x = 0$, or $a^2 = 3x^2$ and $x = \sqrt{\frac{a^2}{3}} = a\sqrt{\frac{1}{3}} = .577\,a$, and making $c\text{E} = \frac{1}{3}\text{A}c$, the perpendicular ED cutting the circumference in D, determines the breadth and depth of the joist. The triangles ADC, AFC, having the same base, they are as the altitudes FH, DE; that which has the greatest altitude is AFC, half of the inscribed square. The joist ABCD is not only stronger than AGCF, but is also lighter and cheaper. The strength of the two are as 10 to 9.186, their weight and bulks are as 10 to 10.607; the joist ABCD is therefore, nearly 15 per cent. better than AGCF.

The strongest joist which has a given girt, is that of which the depth is twice the breadth; for let AD+DC the half girt $= a$, and AD the depth $= x$, then the breadth, or DC $= a - x$, the strength is as $ax^2 - x^3$, and when that is a maximum $2ax\dot{x} - 3x^2\dot{x} = 0$ or $2a = 3x$, that is, the depth must be one-third of the girt, or twice the breadth. In joists of the same content of timber, the thinnest placed on edge is the strongest.

Upon the same principles hollow tubes are stiffer than solid rods, containing the same quantity of matter, of which principle we have some beautiful instances in the quills of birds, the bones of animals, the stalks of reeds and grasses, &c.; and our best engineers now imitate this procedure of nature in forming their mill axles, uprights, and the like, of cast iron tubes.

But another maxim which we find given by writers of of reputation is not to be relied on. A triangular bar pojecting from a wall, with a weight at its extremity, is said to be thrice as strong when one side is uppermost as it will be when one angle is uppermost. This is only true upon the first and second hypotheses, where no account is taken of the compression of the concave side. Having already shown the falsity of this principle, we would observe, that in the supposition of an equal resistance to condensation and dilatation, it is a matter of indifference which side of such a bar is uppermost; for if the broad side be favourable for resisting dilatation, the opposite angle is equally unfavourable for resisting compression. Should the resistance to compression be very great, the proposition would be but partly true, for, in truth, it supposes that resistance infinite. Now we know that, in many kinds of timber, the fibres undergoing compression are more numerous than those which are in dilatation. In such cases the reverse of this proposition is the truth, and the bar will be stronger with the broadside to resist the compression. The exact mode of action is by no means so readily discovered in this particular case; but as this theorem has given rise to several erroneous maxims of practice, we shall endeavour to give the reader a correct idea of it, by subjecting the simpler case to mathematical investigation.

Let ABC, Plate CXII. Fig. 6, be the cross section of fracture of the triangular bar; MN the neutral line, or separation between the parts compressed and those dilated; $o\,p\,r\,q$ an indefinitely thin slip of the fibres. The length of the slip $o\,p$ will be proportional to its distance from the angle; the stretch or compression which it undergoes, will be proportional to its distance from the neutral line; and upon the supposition formerly made, of the resisting force being proportional to the tension, being the law of elastic bodies, the resistance it makes will also be proportional to that distance. Lastly, the lever by which it acts in resisting a bend or fracture, is the same distance, and therefore its energy is as the square of its distance from MN. Take this distance DE$= x$, and making DC$= a$, MN$= b$, we have for the length of the slip $o\,p$, CD : MN : : CE; $o\,p$, or $a : b :: a - x : b - \frac{bx}{a}$, its breadth is x, its magnitude $o\,p\,q\,r$ is $b\dot{x} - \frac{bx\dot{x}}{a}$; and making, as before, f the force of each fibre exerted at the greatest distance a, the strength of this will be $\frac{bfx\dot{x}}{a} - \frac{bfx^2\dot{x}}{a^2}$ at the distance x; its energy therefore by means of the leverage x, is $\frac{bfx^2\dot{x}}{a} - \frac{bfx^3\dot{x}}{a^2}$. The fluent of which, or total energy, is $\frac{bfx^3}{3a} - \frac{bfx^4}{4a^2}$, which, when x is$= a$, becomes $\frac{bfa^2}{3} - \frac{bfa^2}{4} = \frac{1}{12}bfa^2 = \frac{1}{2}abf \times \frac{1}{6}a$. That is, as $\frac{1}{2}abf$ represents the absolute cohesion of the triangle CMN; the actual force is as if the absolute cohesion of MNc acted at the distance of $\frac{1}{6}$ of its perpendicular from the neutral line MN, which is the solution usually given for the transverse strength of the triangle.

Before proceeding farther we may observe, that this shews us the ratio of the strength of a square, or rhomboidal joist, lying on edge, compared with the same joist lying on one side. Upon the supposition of the equality of compression and dilatation, the triangle below will just exert the same strength as the one above, and the whole will be as if twice the absolute cohesion of the half beam, that is, as if the absolute cohesion of the whole beam were exerted at the distance of one sixth of the half diameter from the centre. In the other case it will be as if the absolute cohesion were exerted at the distance of one-third of the side from the centre, and therefore it is stronger in the proportion of 166 to 118. But it must be observed, that the supposition of equal compression and dilatation is the most unfavourable for the diagonal position, the strength of the broadest part of the beam being lost by being in the neutral line.

Let us next inquire into the action of the broader part of the triangles, viz. MABN.—Here, as before, the length of the slip $s\ t\ r\ u$ increases with the distance from C, and calling DF $= x$, we find,

$$a : a + x :: b : s\,r = b + \frac{b\,x}{a};$$

and, by reasoning as before, the energy of the whole MABN will be $\frac{b\,f\,x^3}{3\,a} + \frac{b\,f\,x^4}{4\,a^2}$.

It is evident that we cannot, in this case, take $x = a$ upon the supposition of equality of compression and dilatation. Let us, therefore, assume the whole energy of the side AN, to be equal to that of the side MCN, then making $\frac{b\,f\,x^3}{3\,a} + \frac{b\,f\,x^4}{4\,a^2} = \frac{1}{12}\,a^2\ b\,f$, we find

$$\frac{x^3}{3a} + \frac{x^4}{4\,a^2} = \frac{a^2}{12}, \text{ and } 3\,x^4 + 4\,a\,x^3 = a^4,$$

and taking the root of this equation, we get $x = \frac{a}{1.785}$ or nearly $\frac{5}{9}\,a$, in which case it must be observed that the fibres of the broad side are strained little more than one half of those at the opposite edge. It is perhaps possible, therefore, that a triangular bar may fail at the edge, and yet not be broken by the strain; it would be very desirable that experiments were made on this point.

Upon the principle of equality of compression and dilatation, which is certainly the most probable at the beginning of the bending, it does not appear how the superabundant strength of the broad side of the beam can be brought into action; its superiority, therefore, in one position over another, is a mere deception of hypothesis. But if we suppose the compressibility and dilatability different, which without doubt is ultimately the case in most bodies, (thus oak carries less than fir as a pillar, but more as a tie,) then we may suppose the greater breadth of the side of the bar to become useful in resisting a strain; but this is a question of fact and not of theory, and, according to circumstances, the bar may be best situated either way. In the mean time, it is a question of high importance to the engineer; for until it be ascertained, it is evident that the form of flanges, scantlings of trusses, &c. must be left entirely to chance, and in making them he may, instead of strengthening his work, be only adding a cumbrous load.

We may collect from the above enquiry, that our triangular section will begin to give way at the point, when the distance of the neutral line from the base is $\frac{5}{9}$ of its distance from the vertex, and therefore $\frac{5}{14}$ of the altitude of the triangle: At that time the vertical part being on full stretch, we have its energy acting at $\frac{1}{6}$ of $\frac{9}{14}$ of the altitude of the triangle from the neutral line MN, and the part CMN will be to the whole bar as the squares of the altitudes CD and CR, viz. $9^2 : 14^2 = 81 : 196$, that is, the energy of the vertical part of the triangle is $\frac{81}{196}$ of the absolute cohesion, acting at the distance of $\frac{1}{18}$ of the depth or altitude; the other, or trapezoidal part, must of course be exerting the same energy, so that in triangular bars we may suppose the absolute cohesion acting at the distance of .088, or about $\frac{1}{12}$ of the depth of the triangular bar from the neutral line: or the absolute strength is to the resistance to cross strain, as the length of this beam to about $\frac{1}{12}$ of its depth, so that it is little more than half the strength of a rectangle of equal depth, and the same contents.

We may learn from this case of how much importance it is that the compression should be attended to. By neglecting to do so, some writers of reputation have fallen into serious mistakes. There is another case, similar to this, given by Emerson and others: it is said that a hollow tube becomes stronger by bringing the interior opening nearer to the side, which becomes concave by the strain; but like the above, this depends entirely on the relation between the compressibility and dilatability of the materials of the tube. In like manner we reject the propositions said to point out the strongest position of a beam having a trapezodial section, and others of the same kind usually given by authors; they are merely deceptions of hypotheses. The truth is, that in most kinds of timber the position of the beam is just the reverse of that usually recommended. In most of them we shall find the compressibility to be much greater than the dilatation. The greater dimension must, therefore, be thrown to that side which is likely to be compressed, and a beam broader on one side than the other will be strongest with the broad side uppermost, when it is supported at the two ends.

In stone, however, the reverse is most likely to be the case; but it is needless now to go farther, the reader must perceive that the whole is matter of experiment.

We may see the propriety of several maxims, which have been long familiar to the experienced workman. If a mortice is to be cut out of a beam, the worst place is to take it out of that side which becomes convex by the strain, as (Plate CXII. Fig. 7. No. 1.) The concave side (as No. 2.) will be much better, since its place will be, in a great measure, supplied by the tenon; but towards the middle (No. 3.) will be the best of all, since the parts near the neutral line are suffering little or no strain, and even there it should be placed towards the concave side rather than the convex.

When a *fish*, or strap, is to be applied to a piece of timber, it must be applied to the convex side, as Nos. 4 and 5.

Though we have supposed, hitherto, that the beam is fixed in a wall, and strained by a load at the outer end, it is not difficult to extend the results we have got to the more usual case of a beam supported at both ends, and loaded in the middle.

Let AB, Fig. 8, be such a beam, resting on the props E, F, and bearing the weight W on its middle C. It is clear that the props E, F, between them, bear the whole weight of W; and that the resistance of E, F, produces a strain exactly the same as if two weights e, f, together equal to W, were hung at the ends of the beam $a\ b$, balanced at the prop c; only the forces will have the opposite direction. In this case, we know, that the weights e and f will be to each other inversely, as their distances from the prop c. That is, $e : f :: b\,d : d\,a$; the ends a and b tend to descend, and the beam to part in the section DC. The situation of each half is therefore the same as if the other were built into a wall as far as the part CD; thence we conclude that a beam, which is supported at both ends, and loaded in the middle, will carry twice as much as a beam, which projects half its length from a wall, and loaded at the extremity.

It is evident that the cross strain produced in CD is the greatest; and that it diminishes as we pass towards the end of the beam. For the same force f acts in $g\ h$

by a shorter lever *b g*. If we suppose the weight W shifted off to G, then the pressure on A is as GB, and the lever by which it acts at GH is AG; the effort is therefore as AG × GB, or as the product of the two segments of the beam.

Again, the strain at CD will be as GB × AD, which will also be the strain at GH, when the same weight is applied at CD. We are now therefore sufficiently informed as to the strains produced on one part of the timber, by loads laid on at any other part.

Suppose, next, the ends of the beam prolonged beyond the props to the points M and N, and to be there firmly held down, the beam will be able to bear twice the load W that it carried before. For suppose the part CD to be sawn through, the weight W is just sufficient to break it at A and B; and another weight of equal magnitude would have been required to overcome the cohesion at CD, independent of the exterior support.

It may appear from this, that the joists of floors would be stronger by being built firmly into the walls. But the hold that is thus obtained is much too short to be of great service; and besides, it acts as a powerful lever, in tending to shatter the wall. But when joists can be carried across partitions, purlins extended to three or more truss frames, or rafters extended over the purlins, &c. it is of great importance to make them in one piece, as they are then of double the strength.

Let us now proceed to the strain which arises from a load distributed uniformly over the beam; of which kind the weight of the beam itself is one of the most important.

We must suppose the whole of the load thus diffused, to be united in its centre of gravity, which, in the case of uniform distribution, will be the middle of the piece.

Thus, to find the strain at GH, Plate CXII. Fig. 8. arising from the weight of the beam AB, we may suppose the weight of the beam accumulated in the point D, and the strain, which the weight of a part AD produces at GH, will be as the weight AD×DA×GB.

Therefore the strain on the middle of a beam uniformly loaded, is half the weight of the load acting by the lever DB; and the strain at G is half the load acting by the lever GB, and is therefore greatest of all at the point D, or in the middle of the beam.

Since the strain in the various sections of the beam also varies considerably, it becomes of importance to determine the various proportions of the beam, so that it may be equally strong in every part. The strength must be every where proportioned to the strain; should it be any where greater, this additional power will be useless, for it cannot be brought into action.

Suppose the beam fixed in the wall, and strained by a load at the extremity.

If the upper and lower sides are parallel, *i. e.* if the depth be given, the horizontal section must be a triangle; or the two sides are vertical planes, meeting in an edge at the extremity. For the strength, as we have shown above, is as the breadth, multiplied into the square of the depth, and divided by the length. That the strength may be every where the same, the breadth must therefore be proportional to the length, for the depth is given. See Fig. 9. where $BC \div CE$.

If the breadth be given, we must have the length proportional to the square of the depth, which is done by making the depths the ordinates of a common semiparabola, (Fig. 10.) where $BC^2 \div CD^2$.

If the beam be pyramidal or conical, having its base in the upright wall, *i. e.* if its vertical sections be similar figures, as circles, squares, &c.; then since d^2b is as d^3, we must form the diameter or side so as to have its cube proportion to the lenth, or so as to be the ordinate of the cubic parabola, (Fig. 11.) $BC \div CD^3$.

The same forms are proper for the arms of a lever, observing that the greater of the three pressures is to be applied at the junction of the bases, or thickest places.

It is worthy of remark, that although the different forms of Figs. 9, 10, 11, are all equally strong, they are not, however, equally stiff; Fig. 9. having the upright end, will bend least on the whole; Fig. 10. will bend most, a property which may have its use in forming springs, &c.

It is not necessary, theoretically speaking, that the upper or under side of Fig. 10. should be straight. The proper depth being preserved, we may place the beam either way, divide the curvature between the upper and lower sides, or give the beam any proposed camber. In straight-fibred timber, however, we will naturally put the straight face to that side which is stretched by the strain; as well to prevent their parts from tearing, as to procure greater stiffness. The same remarks may be applied to the other figures. They will occur to the intelligent engineer. It is evident that the same remarks and construction will apply to a joist which is loaded at a particular point, and supported at both ends. It is in the same state as the lever above-mentioned.

When the weight to be supported is uniformly distributed over the beam, the forms are considerably different from these.

The strain on any section arises from the weight distributed over the part beyond it. This weight, being distributed uniformly, will be as the length beyond the section, and it may be supposed accumulated in the centre of gravity, which will be in the middle of that length; so that it acts with a leverage also proportional to the length; and the strain produced is therefore proportional to the square of the length. Now the strength of the section is as the breadth multiplied into the square of the depth.

If the breadth, therefore, be given, that is, if the beam must have upright parallel sides, we must make the square of the depth proportional to the square of the length beyond the section, that is, the depth as the length; and the beam becomes a triangular prism, as Fig. 9. only having the extreme edge at B placed not vertically, but horizontally.

If the depth be given, or if the upper and under sides be parallel planes, then the breadth must be formed proportional to the square of the length beyond the section; and the beam becomes the same as Fig. 10. only placed on the flat side, or the horizontal section is formed by arches of the common parabola.

If the beam must be of a conical or pyramidal shape, or rather if the vertical sections must be every where similar figures, then the cube of the diameter must be as the square of the distance from the end, and the sides of the beam are arches of the semicubical parabola.

It is evident that the same observations as formerly made respecting camber may be again repeated here.

It will not now be difficult to apply these deductions to the form of a joist uniformly loaded through its whole length.

We have already shown that the strain on any point C, Plate CXII. Fig. 8, from a load laid on another point G, is proportional to the rectangle GB×AC, being the distances of the points G and C from the ends next each. The strains, therefore, which are produced at two points on the same side, will be to each other as their distances from the end; and the strain under the load is as the rectangle of the segments on each side, and is therefore greatest in the middle.

For the strain produced at any point G by a load uniformly distributed, we may suppose the load on the part GB accumulated in its centre of gravity, which will therefore be distant ½GB from B; its effort at G will be proportional to ½GB×GA; and the load in the part AG will, for the same reason, produce a strain as ½GA×GB; the sum of these will therefore be likewise proportional to the rectangle of the segments AG and GB; and we have the same proportion of strain for the load uniformly distributed, as for a load laid on directly at the point G; wherefore, *to make a joist equally strong in all its parts against a load laid on at any point taken at random, or against a load uniformly distributed over it, we must have the strength at each point proportional to the rectangle under the two segments of the beam.*

If therefore the breadth be given, the square of the depth must be every where proportional to the rectangle of the segments, that is, the depths must be the ordinates of an ellipse.

If the depth be given, the breadth must be as AG×GB.

If the beam be pyramidal, or have its cross sections every where similar, the cube of the diameter must be as the rectangle of the segments AG×GB.

The joist which is loaded at some particular point will be of equal strength throughout, when the strength of each transverse section between the load and either end is as the distance from that end. It is needless here to repeat the forms, being merely extensions of the Figures 9, 10, 11, to the opposite side, at the point of support, which here becomes the point loaded.

The strain upon a beam may be merely that arising from its own weight. The determination of the proper form for such a case is not quite so simple as the others, for the very form which is sought must be known ere we can discover the weight to be resisted.

To consider this subject in a familiar way, it is evident that the increase of breadth merely gives no additional strength, since the load to be resisted increases along with it. The increase of length diminishes the strength, first, by increasing the load; secondly, by increasing also the leverage with which it acts.

The increase of the depth, though it brings a proportionally greater load, yet, since the strength also increases as the square of the depth, the resistance to fracture increases with the depth; and we may on the whole infer, that the power of a beam to carry its own weight, is directly as its depth, and inversely as the square of the length. We must therefore make these two dimensions proportional; that is, the depth CD, Plate CXII. Fig. 10, the breadth being given, must be proportional to the square of the distance BC, or the side BDF must be the curve of a common parabola.

The reader acquainted with the art of analysis may wish to see this problem resolved in another way. Let the distance BC$=x$, and CD$=y$, CDdc an indefinite small increment of the magnitude, it is equal to $y\dot{x}$. Its momentum round the fulcrum B is $xy\dot{x}$. Suppose now that y is as x^m, or as some power of x, then the contents, or weight of BCD is $\frac{x^{m+1}}{m+1}$; also $xy\dot{x}=x^{m+1}\dot{x}$, of which the fluent or whole momentum is $\frac{x^{m+2}}{m+2}$. The distance of the centre of gravity of BCD from the point B, will be found by dividing this by the weight, viz. $\frac{x^{m+1}}{m+1}$, the result is $\frac{x(m+1)}{m+2}$, and the distance of the same point from c is $x-\frac{(x^{m+1})}{m+2}=\frac{x}{m+2}$. Multiply this by the weight, or $\frac{x^{m+1}}{m+1}$, and we have the strain, or CD$=$ $\frac{x^{m+2}}{(m+1)\times(m+2)}$. This strain must be as the square of the depth, the breadth being given, or as y^2, or as x^{2m}, therefore $m+2=2m$, and $m=2$, or the depth is as the square of the distance from the extremity, as before.

It is evident, that a projecting beam becomes less able to bear its weight as its length is increased. An enlargement of the depth gives us strength only proportioned to that enlargement, while a proportional enlargement of the length gives a strain which is as the square. By enlarging any structure, therefore, we weaken it. By diminishing it proportionally, we strengthen it. This increase of relative strength allows a reduction of weight and stuff, by which means we have a diminution of expence, and an increase of mobility. Hence, a structure may appear very strong in the model, which will not hang together in the great; and there seems to be a limit set by nature to the increase of structures composed of given materials. The cohesion of the tree is greater than that of the shrub, which again is greater than that of the herb. The sapling gets firmer as it increases to the oak, which, were it to grow 50 times bigger than it is, could not stand, though, with the lightness of fir, it should have the toughness of iron. Were a man twice as long as he is, he would break his bones by falling along.

We have hitherto considered the strain as acting perpendicularly to the beam: This is the simplest case, and one of most frequent occurrence; but it often happens that the load acts obliquely to the beam. The slanting rafter, for example, is obliquely strained by the weight of the roof, since gravity acts in vertical lines.

It is not difficult to compute the effect of this modification, as far as to find the equivalent perpendicular pressure. Let the load W, Plate CXII. Fig. 2. act in the line CX, and be represented by it.

Then, according to the usual theory of the reduction of pressures, its effect will be equivalent to two others, viz. CT directly across the beam, and CV in the direction of the beam; CX is to CT as radius to the cosine of TC, wherefore the cross strain is diminished in the ratio of the cosine of the angle of obliquity from the perpendicular. This is all that is usually given by authors on this modification of strains; and they thence infer, that an oblique beam OP will bear as great a load, Plate CXIII. Fig. 1. as the horizontal beam MN, of which the vertical section is the same.

But this is a very imperfect view of the subject. We might as well infer, that a beam perfectly upright need have no thickness, which would be absurd. There is one part of the strain kept out of view. The beam is loaded lengthwise, by being pressed or drawn longitudinally by the force CV. We must provide for this force, in addition to the strength required against the cross strain. And, independent of the strength which this load requires, the resistance to the cross strain itself is greatly modified by it. The quantity of the beam in Plate CXII. Fig. 4, which is under compression, will be increased; when XCV is an acute angle, the neutral point D will therefore be nearer the upper side, and the quantity of fibres under dilatation will be diminished. The reverse will be the case when the oblique force acts in any direction beyond the perpendicular CW, so that VCX becomes an obtuse angle. The dilated part will then increase, and the part under compression will diminish. We know too little of the corpuscular forces, to say exactly what may be the effect of this; but it is clear, that it may tend materially to weaken the beam. The compression or extension may be so very great, that a very small cross strain may suffice to complete the rupture; yet this is a case which is sometimes unavoidable. The most enormous strains to which framings of carpentry are subjected are of this kind; and the skill of the engineer is particularly shown in reducing every load to a direct pressure or pull in the length of the beam, and to avoid every thing which may tend in the smallest degree to disturb this arrangement. By the settling and sagging of the work, pieces come often to exert very various and yet very considerable strains, which were originally supposed and intended to be inactive.

When the oblique load upon a beam is such, that it increases with the increase of length, as the roof over a rafter or the like, we have another reason for giving the beam a greater scantling. If MN and OP, Plate CXIII, Fig. 1, be loaded equally per foot in length, OP carries more in the ratio of PD to DN. To be equally strained, therefore, DP must be made broader, or placed nearer its neighbours, in the ratio of DP to DN; or its depth increased, in the ratio of the square root of DN to the square root of DP. In the case of a rafter, it is to be observed, that the weight increases as we pass downwards; and hence they must be thickened below. In a kingpost, on the other hand, the weight of the post itself is a load which increases towards the top; and we place the thick part of that post (as it is improperly called) to the upper end.

We may now return again to the case of a beam compressed lengthwise, which is liable to be so much modified by the resistance to bending.

It is needless to inquire how a pressure acting on a straight beam or post in the direction of its length can bend it. It is evident, that the case arises from the unequal compressibility of the sides. One side of the beam must be supposed to act as a fulcrum, to enable the incumbent weight to compress the other side. But this state of the case soon ceases. As the compression goes on, the fulcrum or centre of support shifts gradually towards the concave side; and when the post is so far bent, that the line of direction of the load passes without it, the concave parts must be in a state of compression, and if the post supports the load, the convex parts must be in a state of extension. This situation of things bears an intimate resemblance to the action of a cross strain on one end of a beam, of which the other end is built into a wall; we may say, it is exactly the same with the condition of such a beam, when pulled in the same direction as that in which the load acts.

Let ACB, in Plate CXIII, Fig. 2, represent the position of the neutral fibre; then drawing the perpendicular DC, we may say, that the strain on the section *c f* is the same as if the weight A were applied at the end D of the lever DC *e*, of which *e* is the fulcrum, and balanced by the resistance to compression in the part C*f* and to dilatation in the part C *e*; or as these two resistances must be equal, we may conceive it balanced by twice the resistance to dilatation in the part C *e*, in addition to its own weight.

If, therefore, we knew exactly where the neutral point C was situated, we would thereby be enabled at once to determine the strain on a post or strut, which was bent to a given degree. But, unfortunately, theory seems here to fail us. The proportion between the extension and compression produced by equal forces can only be learned by experiment.

We may, however, draw some useful general inferences.

I. It is evident, that the greatest strain will be at the place where the post is most bent from the straight line. For the arm of the lever DC will then be the greatest, and it is not likely that the arm C *e* will be any where less.

II. The strain appears to be nearly proportional to the distance of the section from the line AB.—But we cannot say so with certainty, as there may possibly be the same change in the arm beyond the neutral line, as in the part CD, by a shift in the virtual fulcrum. Euler, therefore, the only author of reputation who has treated of this subject, and after him Emerson upon Euler's principles, have fallen into considerable errors, when they say the strain is proportional to the ordinate CD, or rather *f*D, as they have it. In the first and second hypotheses above mentioned for the cross strain, this would be indeed true; but we have already shown the falsity of these hypotheses, and the necessity of attending to the compression. If that be necessary in treating of the strain directly across, it is still more indispensible here, where the very essence of the strain consists in its compressing the timber.

In the great and most dangerous loads, as the trussed centres for heavy vaultings, or the like, the compressed part occupies the greater part of the section, which, by removing the neutral point very near to the convex side, not only increases the strain, by extending the arm DC, but diminishes the power of resistance, by leaving fewer fibres for distension; and these few acting by a shorter arm of the lever than before. Upon this principle, we may again account for the facility with which a very trifling cross strain is enabled to break a beam which is under very great compression.

III. At the point B, where the crooked beam is intersected by the line of direction of the load, there is, properly speaking, no cross strain; it does not follow, however, that there is no strain at all, as Euler has hastily supposed. The truth is, the strain is of the simple lateral kind, and the upper part AB tends to part from the lower, by sliding along the section OP. The strain is the simple load A, laid on at the point O, and the strength resisting it is as the depth or area of the section OP, as mentioned in the section on lateral resistance.

We would have proceeded to compare the theoretical investigation just given with the results of experiment; but, as we have already stated, there are few of that kind recorded, which can be turned to any good purpose. The compressibility and dilatability of the timber has been seldom thought of, at least so far as to subject it to experiment. We can therefore infer little from the numerous experiments on the transverse strength. The various series of experiments by Belidor, Duhamel, Buffon, &c. seem in general to confirm the truth of the strength being in proportion to the breadth and square of the depth, directly and inversely as the length. Those, indeed, of Buffon, by far the most valuable that are on record, and which, by being made on large scantlings, were free from the irregularities unavoidable in small specimens, would show that the strength diminishes in a ratio greater than the inverse proportion of the length; and reasons might perhaps be given why it should be so. But we have already occupied too much time on this subject; and perhaps it will be better to give the practical carpenter a simple arithmetical rule derived from these experiments, the result of which very nearly coincides with them, for finding the weight which will break a bar of any scantling.

Divide the number 651 by the length in feet, subtract 10 from the quotient, multiply the remainder by the breadth into the square of the depth, both expressed in inches. The result is the greatest load in pounds. This rule applies only to scantlings of oak.

Example, Required the weight necessary to break an oak beam of 8 inches square, and 18 feet long, between the supports.

$$\frac{651}{18}-10=26.16 \text{ and } 26.16\times8\times8\times8=13384.$$

The experiments of Buffon give 13200.

Ex. 2. Required the weight for a 4 inch bar of 7 feet long.

$$\begin{array}{l} 7)651(93 \\ \quad\quad\;\; \underline{10} \\ \quad\quad\;\; 83\times61=5312. \end{array}$$

Buffon's experiment gives 5312.

Observe, that this weight is that which will break the beam in a few minutes. One half of this load may be safely laid on the beam, but will give it a set which it does not recover. One third may be laid on it for any length of time without injury.

It is to be regretted, that we have no series of experiments on the other kinds of timber. Fir is said by Buffon to be $\frac{6}{10}$ of the strength of oak; Emerson makes it $\frac{2}{3}$; Parent $\frac{10}{12}$. We shall adopt the proportion $\frac{2}{3}$ds as a sort of mean.

Required the load which will break a beam of fir of 14 feet long and 3 inches broad, by 5 deep.

$$\begin{array}{l} 14)651(46.5 \\ \quad\quad\quad\;\; \underline{10} \\ \quad\quad\quad\;\; 36.5\times5\times5\times3=2737\tfrac{1}{2} \text{ weight to break an oak beam.} \\ \quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\;\; \underline{2} \\ \quad\quad\quad\quad\quad\quad\quad\quad\; \underline{3)5475} \end{array}$$

$\frac{2}{3}$ of this, or 1825 lbs. to break the fir beam.

Required the load which may be borne by the same beam with safety at 4 feet from one end.

4 × 10 : 7 × 7 :: 40 : 49 :: 1825 : 2235 lbs. will break the beam there. One third of this, or 745 lbs. may be borne with safety.

According to Emerson's experiments, a rod of good oak, one inch square and one yard long, supported at both ends, will bear in the middle a load of 330 lbs. avoirdupois; but this only for a short time, and it breaks with more. The rule above mentioned would only give 207 lbs.; and, as Emerson says, that $\frac{1}{3}$ or $\frac{1}{4}$ of this load only may be depended on, we think, on the whole, the rule above given from Buffon may be safely trusted to in practice. Emerson also states the relative strength of other timber as follows:

Oak, plumb-tree, yew,	11
Ash, elm,	8½
Thorn, walnut,	7½
Apple, elder, red fir, cherry, and plane,	7
Beech, cherry, hazle,	6⅔
Alder, asp, birch, white fir, willow,	6
He adds to these—	
Iron,	107
Brass,	50
Bone,	22
Lead,	6½
Fine freestone,	1

V. *Of the Resistance to Twisting.*

This is the strain that is of most importance in the axles of mills or other machinery, in screws of all kinds, and in the rudders of ships; it frequently also occurs in masts. If we suppose the twist to be confined to one plane of section passing directly across the axle, as to the joints between the two parts of a flute, we must suppose the resistance to arise from the force of cohesion in the particles, and to have some relation to their number. It is clear that the particles on the outside of the axle will be more strained than those nearer the centre. As heretofore, we may suppose them exerting proportionably greater forces. The section will give way when the exterior particles begin to give way; for a particle nearer the centre, though strained to the same degree, acts by a shorter leverage. When the section begins to give way, therefore, we may suppose each particle to be exerting a force proportional to the distance from the centre. The number of particles in any ring or circle, is as the distance of that circle from the centre. Wherefore the effect of each ring will be as the square of its radius. But the number of rings is also as the radius of the axle. Wherefore we find a very simple rule for the strength of axles, viz. It is proportional to the cube of the diameter.

We may draw several useful conclusions from this principle, even before we endeavour to determine the amount of the resistance to twisting, by drawing it from the direct cohesion.

It is plain that the interior parts of the axle are not acting so powerfully as those towards the outside. Suppose we bore out the heart of the axle as far as half the diameter, the strength of the remainder will be as the difference of the cubes of 1 and 2, that is, it will be $\frac{7}{8}$ of the entire piece, but the stuff is diminished one fourth. A saving is therefore practicable in this way, since a hollow axle may be formed, which, with the same degree of strength, would contain much less stuff than a solid one. The hollow axle is also stiffer than the other, as we have shown when treating of cross strains, and it affords a much better fixture for the flanges and arms. It is with good reason, therefore, that this improvement has been of late introduced in the formation of axles and large masts.

The whole cohesion of the exterior circle of particles being supposed exerted, the force of any interior circle will be less than that in the proportion of the squares of their diameters or radii. The effect of the whole, therefore, will just be $\frac{2}{3}$ds of the lateral cohesion of the section, or one-third the force required to cut the piece across, by means of a square edged tool. The force required for this, as we have already mentioned, appears from experiment to be considerably greater than that which would pull the parts of the beam directly asunder.

To determine the effect of this, in resisting an external force which tends to break the axle, let f represent the lateral cohesion of any particle, r the radius of the arch, x the distance of any circle from the centre; then x is the fluxionary increment of the radius, or breadth of an indefinitely small concentric ring, we have the force of any particle as its extension, or as the distance x from the centre. That is, $r : x :: f : \frac{fx}{r}$, and the cohesion of the part $\dot{x}$ is $\frac{f x \dot{x}}{r}$; taking π as the number 3.1416, we have the cohesion of a ring $= \frac{\pi f x^2 \dot{x}}{r}$; its energy is found by multiplying this by the length of lever or distance x, and is therefore $= \frac{\pi f x^3 \dot{x}}{r}$; the fluent of this is $\frac{1}{3}\frac{\pi f x^4}{r}$, which, when $x = r$, gives for the whole energy of the axle $\frac{1}{3}\pi f r^3$. Now πr^2 is the area, and $\pi f r^2$ is the lateral cohesion of the section; wherefore the energy will be found by supposing the whole lateral cohesion exerted at $\frac{1}{4}$ of the radius from the centre.

Example. Required the weight which would wrench off an axle of fir 1 foot in diameter, acting on it by a lever or wheel at the distance of 3 feet from the centre.

Take the absolute cohesion of fir 8000 lbs. per square inch.

$8000 \times 144 \times .7854 = 904881$, the cohesion of the section;

36 inc. : $1\frac{1}{2}$: : 904781 : 37700 lbs. weight required.

Though the length of the axle has not been alluded to in these deductions, it is probable that a considerable degree of importance should be attached to it. In fibrous matter, such as timber, the fibres will be twisted up like a skain, and made to close upon each other. The diameter of the axle will be somewhat diminished, and with that the energy of each fibre. The twisting produces also a species of cross strain upon them, while they are violently drawn in length; so that on the whole, the length of the axle seems to have somewhat of the action of a lever in facilitating the disruption. It is not easy to subject this to calculation; but it is obvious that the result for a simple twist will be thereby considerably reduced.

The various forms into which timber may be bent are innumerable, and to discuss completely the strains to which even the most simple and common may be subjected, would be occupation for volumes; nevertheless we cannot entirely omit them. We have already, in examining the effects of bending, when treating of cross strains, stated some of the most important conclusions. We shall now, therefore, be very brief. Let ACB, Plate CXIII. Fig. 2, be the piece of crooked timber, loaded at A to the utmost. Join AB, draw the perpendicular *e* C *f* D. Let ACB represent the neutral fibre. It is evident that the first change likely to take place, is the slipping of the fibres on each other; for as the beam bends under the load, the concave parts will be somewhat protruded beyond the convex: the parts A *e* B are stretched. And we might consider the whole as a framing, in which A *f*, *f* B, *f e* are struts, and A *e*, *e* B are ties. But this would necessarily lead us to anticipate other matter; we shall therefore consider the weight A as applied to the virtual lever DC *e*, of which the fulcrum will be C. The weight of A applied to D will be balanced by the resistance to extension in *e* C, an equal resistance to compression in C *f*, added to the weight of A, also compressing *f* C; since the force in *f* C will be equal to the sum of the other two in the opposite direction.

Now the weight of A is constant. The extension in *e* C, and equal compression in C *f*, will therefore increase with, and be proportional to, the distance CD. Its amount would be known as aforesaid, did we know the position of the neutral line. The part C has a tendency to fly out from AB, which is resisted by the extension AD; so this tendency of C to fly out is measured by the cosine DC, which shows also the strength of the bridle that should prevent it. Hence we may observe, that cross bridles made to preserve straight posts from yielding, may be vastly smaller than those fir beams which have already taken a set, or were originally crooked.

If the piece ACB were under distension, the reasoning and magnitude of the parts would be the same, the mode of action of the concave and convex sides only changing. And in like manner, by attending to the virtual leverage, it will not be difficult to form a conception of the mode of action in every oblique strain. When the beam ACB is distended, the parts C *e* and C *f* will tend to part from each other, and hooping the beam there may have a good effect. The same thing is likely to occur in various other instances.

When the piece is exposed to a cross strain, acting in CD, and the ends A, B have abutment, each part is undergoing a longitudinal strain, the amount of which, in proportion to the force applied, is greater, as AD to DC nearly, and may readily be discovered by the resolution of forces. When the parts A and B have no abutment, then the parts B *f* A must resist by being extended, and the case returns to one in which the parts AB are distended. It is evident that the power of the cross strain will be greater the nearer ACB is to the straight line. In such a case again, hooping the part *e f* must be useful; and the carpenter of the bridge of Schaffhausen has very properly introduced it. And upon similar principles, we should doubt the propriety of such erections as the Coalbrookdale bridge and others, where several parallel and curved bars are exposed to strains of this kind, without proper pains being taken to secure the connection between them.

Of Joints.

Having now considered in general the various kinds of strains which occur in the works of the carpenter, and having endeavoured, as far as was in our power, to shew how the strength of the timber is made to resist them, and how this resistance can be brought under calculation, we proceed to examine upon similar principles, the modes of connection by which these strains are propagated through the different parts of a framing. Upon this part of our subject we shall be the more brief, as it is handled in more detail in the practical part of this article, by a gentleman of well known ability. Another opportunity will occur for treating of the more complicated framings, as trusses, roofs, centres, bridges, ship frames, &c. where we can consider this subject upon principles that are common both to carpentry and iron work. In the latter, we can form frames composed of one single piece, and we can, in like manner, accommodate the thickness and breadth of the parts, or their length, to the strength we require, or the uses they are applied to, without any weaker connecting parts. But in the former, we must accommodate our framings to the size of our materials; and when these are too small, we must endeavour to join or piece them, till the requisite magnitude or strength be attained. The best method of constructing these joinings, is one of the most delicate parts of the art of carpentry.

The different forms are very numerous. Each of them has its advantages in particular cases. The leading principle with the carpenter and joiner should be, to make every joint, even those intended only to please the eye, as strong as the case will admit. He will attend to the changes that may take place in his work, by swelling, or shrinking; for as this is a force altogether insuperable, unless the change in the whole assemblage be made to act in the same direction, he cannot prevent the smaller parts from crushing or tearing away.

When the thickness or depth of a beam is to be increased, other pieces are applied over or under it. If the strength of the beam is to be combined with pliability, these pieces are not fixed to the beam, but bend and yield gradually like the plates of a coach-spring, Plate CXIII. Fig. 3. Where the assemblage is intended to act like an entire log, the parts must be attached together. Iron or wooden bolts may be driven through them, or they may be *dowelled* within, by letting pieces of tough wood into the solid on each side of the joint, Fig. 4, 5. The pieces may be fitted into the face of the joint like tenons, or driven across it like keys or wedges. They may be also attached by *coaking*, or tabling, Fig. 6, 7, &c. which is uniting two or more pieces together in the middle by small tabular parts formed from the solid of one, and sunk into corresponding cavities in the other: the butts or ends of these prevent the pieces drawing asunder lengthwise.

When the butting surfaces brought into action are equal, *dowelling* (Plate CXIII. Fig. 5.) is certainly preferable to coaking or tabling, for this obvious reason, that the depths of the two beams are preserved entire; and we know that the thicker beam will be stronger, in proportion to the greater distance of the compressed or dilated fibres from the neutral line. Observe, however, that the beam is not stronger in proportion to the square of this greater depth, for the quantity of fibres left entire is supposed, in both cases, to be the same. If the fibres which are cut across be contained within that part of the beam that is compressed, and if close work be made, the assemblage will, indeed, be nearly as powerful as a solid beam of equal depth, which is a still stronger reason for preferring the method of dowelling; nevertheless, perhaps, because it appears more ingenious, many carpenters appear to prefer the other.

The intention of both these methods of joining, is to prevent the two pieces from slipping on each other. Where there is no great risk of that, the indenting need not be very deep; at all events, when the butting surfaces are so great as to be able, without crippling, to shove off the coak along the plane, there can be nothing gained by making them deeper. When the one piece is tabled into the other, we have an increase of hold and consequent strength, by deepening the indenting so far; but we have also a diminution of strength, by lessening the scantling of the beam. There is therefore a maximum here, or certain depth, to which we should cut, so as to make the strongest compound beam of two given balks. Duhamel has made a number of experiments, with a view to determine this point; and it appears from them, that the depth should be about one-eighth of the depth of the two balks, or one seventh of the compound beam.

Many artists use an oblique scarfing, instead of square tabling, as Fig. 8. This practice does not appear advisable; the sharp corner is apt to be crippled. Dovetailing them, as in Fig. 9. seems also injudicious; the pieces are then apt to tear each other up. The experiments of Duhamel appear clearly to favour the method of square tabling, and it has the advantage of acting both ways. The dovetailing appears intended to take a hold of the two pieces, and prevent them from parting. There is a very ingenious method of fixing dowel pins and tree nails in that way, which may be applied to other joints in carpentry. A little split is made in the end of the tree nail, and a small wedge struck in it; this wedge is driven home when the bolt reaches the bottom, expands the end of it, and squeezes it firmly against the side of the hole.

Two beams are often connected side by side, with the intention of resisting strains in the direction of the plane of the joining, or rather with the view of resisting a strain in every direction, as is the case with the parts of a mast, or an axle. The feather and groove, used in flooring, is of the first kind, and it is sometimes employed in joining beams. The feather loosens by the unequal shrinking of the beams, and then it may slide in the groove. Besides, this form gives a hold only in one way, and is therefore unfit for masts or axles. Tabling the pieces together, or keeping them through in the plane of the joint, would be improper here, so much of the exterior fibres as are cut across by the tabling are unfit for distension, and therefore the compound beam will be weakened against a strain in the direction of the joining. The one piece may also slide on the other in that line, at least so far as to admit of serious bendings, and the form would have no resistance against twisting.

The lateral slide is prevented in mast-making, by dividing the joint along the middle of its breadth, and placing the projecting tablings alternately on either side (Plate CXIII. Fig. 10.) Thus *a*, *b*, *c*, are projecting parts, and *d*, *e*, *f*, are depressions, the other piece being formed in the same way, the projections of the one fit into the depressions of the other, viz. *a* into *d*, *b* into *e*, and *c* into *f*, which prevents the beams from sliding on each other, either longitudinally or transversely, and resists twisting completely.

Even this form is not without its defects; for, independent of the jagged appearance of the seam, which is unsightly, and lodges water, that part of the exterior side of the beam which is occupied by the tabling, is not capable of resisting distension; and this, in the case of a round mast or yard, becomes of much consequence, as it occupies precisely the most favourable situation for that purpose. The mast-maker, therefore, perhaps with no other view than to make a fair joint, does not carry his tabling to the exterior side, but leaves two or three inches, of what he calls good wood, keeping the coaks at that distance from the edge of the beam, Fig. 11. This is certainly a good practice; and, of itself, sufficient to prevent the lateral sliding. The coak is thereby placed in that part of the beam which is near the neutral line. It is not subject to strains, for which it is not calculated, yet is sufficient, by its abutment, both laterally and longitudinally, to make a good connection of the pieces.

Another method, called a running coak, is in frequent use in the dock-yards. The coak is continued the whole length along the middle, but the butts project on each side of the middle line alternately, so as to be one-third their breadth within and without each other. This method has some advantages, as the coaks have a hold both by the bottom and one side, Fig. 12.

There is still another method of forming the alternate tabling, which not only gives a smooth seam, but is also better fitted to resist twisting than the running coak. The tables have their full depth in the axis of the joining, but are sloped off towards the outside like so many wedges, and end there in a straight edge. This form has the full strength of its fibres at the exterior side against every strain, and the connection formed at the axis is sufficiently firm to make the parts act together, Fig. 13.

All these forms admit of hooping well; and by making the interior part somewhat full, we may compress the soft heart of the tree so far as to render the assemblage much stronger than an entire tree of equal size.

Timber is also pieced, in order to increase its length; and there are a variety of methods of effecting this, some of them very ingenious. The strongest, and at the same time the simplest, method of lengthening a beam, whether it be a post, a tie, or a rafter, is to compose it of several pieces, which are so placed that they may break joint, to use the mason's phrase. The necessary connection among them can be given in any of the ways we have just mentioned, Fig. 14. We are thus enabled in ties, to make certain of the cohesion of all the pieces but one; and it is obvious, that the strength increases with the number of pieces. Besides, the connection among them becomes the more certain, in consequence of the increase of the surfaces of attachment.

Fishing a beam is something of this kind. It consists of clapping a piece of solid wood over a joint, and attaching it firmly to both parts, either by bolts or tabling. (Fig. 15.) A strap is frequently placed over such a joint, connecting the heads of neighbouring bolts. This is merely a *fish* of iron.

An eminent writer has said, that no tie of the same thickness of timber can be so strong as two pieces laid over each other for a certain length, and bolted together. (Fig. 16.) Now this is certainly wrong, for that very assemblage may be made stronger by dowelling across the joint with a thin key. Neither is the form of Fig. 17. No. 1. so strong as the other mode, where the pieces have a square abutment, and is every way stronger than No. 2. But as a tie, the case is very different.

The bolts are the only means of connection, and as great dependence seems frequently had upon that sort of fastening, it may be worth while to examine it a little more closely. It is clear, that whenever we pass the joint RU, we can have only the tenacity of one half of the beam ASTC. Fig. 17. No. 3. Now, how do we take hold of the other part RUDB? It is by means of a bolt, and we hold this by means of the bit beyond it. This piece is only kept in its place by the connecting matter, which attaches it to the fibres. Our only hold, therefore, is a thin plate of the connecting matter on each side of the bolt, and parallel to it. The second bolt gives us a hold of more of the connecting matter, but that still acts by means of the same fibres; and the third bolt does also the same thing, which shews, by the way, the impropriety of placing all the bolts in one line along the fibres, as is frequently done. But besides this, when the part comes to be stretched, the bolts will necessarily yield a little, and then bear only on one side of the holes; the fibres near the junction may be expected to yield; their number resisting an iron bolt is small, and the position of the bolt enables it to act as a lever in crippling them. Accordingly, such bolts quickly work loose, and, in reciprocating strains especially, the assemblage is very apt to give way at once. Placing a strap over the joint to connect the various bolt heads, may prevent the leverage above mentioned, and will be an unquestionable benefit against a transverse strain. But, even with every precaution, the firmness which appears to be produced by bolting, when carefully considered, is by no means so great as is generally imagined. The key placed across the joint of Figs. 18, 19, brings as many fibres into action as a bolt, and being so much shaken, is not exposed to any leverage, and consequently cannot cripple the fibre in that event. This key need be no thicker than just to take hold of the wood, without tearing it up; the greater the distance between these mortices, the deeper they must be cut, since the greater will be the lateral adhesion. As to the breadth of the key itself, this must depend on its hardness; and, in order to have it as small as possible, it is common to make it of some much harder substance than the beam, as of oak, or of iron. The latter is said to be apt to cripple the fibre; but perhaps this is more to be ascribed to injudicious driving, for these keys are usually made with a small taper, and, in order to obtain firmness and closeness, the workman is apt to proceed too far. Every species of connection in carpentry is liable to this defect, and the necessity of guarding against it must be carefully and constantly impressed upon the workman. The joints should be close, and all motion prevented, and the pieces made firmly to adhere, that no corner or single fibre may be unequally loaded; but any thing beyond that is useless and dangerous.

Since, therefore, the apparent firmness of adhesion, produced by bolts and screws, does not communicate any real additional strength, and that an equal adhesion may be produced even by a wooden connection, the ingenuity of the carpenter is left more at liberty; and it may not be improper to inquire, whether stronger modes of adhesion are not to be found than those either of Fig. 17, or 18. It is unquestionable, that if the two surfaces of No. 2. Fig. 17. were tabled together, the joint would be greatly stronger, and this can be done with very little, if any loss of wood; nay, the adhering parts near the ends of the joint being so near the edge, and of course so much farther removed from the neutral fibre, would render the assemblage stronger against a transverse strain than even Plate CXIII. Fig. 17. No. 1. The tabling will be more perfect by lengthening the joint, that is, by making it more oblique. But there is a limit to that, independent of the waste of timber; for when the distance between the alternate projections is so great, as to tear the fibre ere the connecting matter part, there can nothing be gained by increasing the surface of attachment. Fig. 20. exhibits another method of piecing a beam, which will enable it to resist a considerable transverse strain; and, as a tie, it is at least as strong as any such form as Fig. 17. The lower piece is supposed to be oak, and by tightening the key above, its transverse strength is greatly increased. Duhamel has made many experiments on an assemblage somewhat similar to this, and has shown us, that this built beam of three pieces may, in some cases, be much stronger than an entire one. The ingenious carpenter will see, that the principle is capable of being applied in many other situations. As a tie, its chief value consists in taking hold of several plates of fibres. We may clap another such fish on the top, and so double the connection. But we have already said enough on this subject, which would require much more room than we can spare to treat of it completely. Hereafter we shall see, that much more powerful assemblages may be formed by framing. See the article FRAMING. (A. S.)

PART II. CONSTRUCTIVE CARPENTRY.

BEFORE we enter upon the consideration of this important subject, we must first lay before our readers a few preliminary problems of a geometrical nature, relating to angles, tangents, arcs of circles, elliptic, parabolic, and hyperbolic curves, circular and elliptic polygons, concentric ellipses, and other subjects which are absolutely necessary to a proper understanding of the art of Carpentry. From these preliminary problems, the reader will be naturally led to the Stereographical Principles of Carpentry, which are also of indispensible use in Architecture, Joinery, and Masonry.

BOOK I.

Preliminary Geometrical Problems.

1. From a given point A, to draw a tangent to the arc of a circle BD, Plate CXIV. Fig. 1.

Join the centre C and the point A; on AC as a diameter, describe a semicircle CBA; draw BA, which is the tangent required.

2. From a given point A in an arc ABC, to draw a tangent, Fig. 2. without having recourse to the centre.

From the point A, with any radius, describe the arc DBE, and with the same radius from B, describe an arc at C; join AEC; make BD equal to BE, and draw AD, which is the tangent required.

3. To describe the segment of a circle, having the chord AB and the versed sine CD given in position, Fig. 3.

Produce DC to E, and make the angle AED equal to the angle EDA; from E, with the radius ED or EA, describe an arc ADB, which completes the segment.

4. To describe a segment by means of an angle, the chord AB and versed sine CD being given in position, Fig. 4.

Fasten two rods DE and DF together at D, so as to make the angle ADB, each rod not being less than the chord AB; fasten the rod GH to the other two, so as to keep the angle ADB invariable: Having put a pin at A and another at B, bring the angle at D to A; then move the apparatus so that the rod DE may slide upon the pin A, and DF upon the pin B, until the point D arrive at B, and the point or pencil at D will then have traced out the arc ADB. This apparatus is rather cumbersome; in order, therefore, to perform the operation more conveniently, let the same data be given Fig. 5; join BD, and draw DE parallel to AB; make DE at least equal to DB; form a triangle BED; put a pin at A and another at D; move the triangle round, keeping the side DE upon A, and the side DB upon D, until the point B arrive at A; and this will describe one half of the segment, the other half will of course be described in the same manner. In many situations it is very inconvenient, and frequently impossible, to find a centre. These two last methods are well adapted for this purpose, particularly the last, as it only requires half the distance at the ends of the chord that the former requires; but should there be no distance, or a very small space at the ends, the following method, by finding points, will then be most convenient.

5. The same things being given to find a number of points, in order to trace the path of the arc, Fig. 6.

Draw AE parallel to CD, and DE parallel to CA; produce DE to F; join AD, and draw AF perpendicular to AD: divide AC and FD each into the same number of equal parts; from the points of division 1, 2, 3, in FD, to the points of division 1, 2, 3, in AC, draw 1 *a* 1, 2 *b* 2, 3 *c* 3; also divide AE into the same number of equal parts; from the points of division 1, 2, 3, draw 1 *a* D, 2 *b* D, 3 *c* D, and trace the curve A *a b c* D, which will be the one half. The other half is found in the same manner.

6. To trace the curve of an ellipse through points, the transverse AB, and the semiconjugate axis CD, being given, Fig. 7.

Take a slip of paper, the edge of an ivory scale, or a rod of any convenient length, and mark the distance *g c* equal to the semitransverse CA or CB, and the distance *g f* equal to the semiconjugate CD.

In DC produced, take any point *e*, and apply the point *c* of the slip to the point *e*; cause the slip to have an angular motion, until the point *f* fall upon the axis AB at *f*; then mark the point *g* on the plane of description, and the point *g* will be in the curve of an ellipse: in like manner all other points *h*, *i* are to be found. If AB and CD were produced, and *f* made to move in AB, the point *g* will describe the curve BDA, which will be a semiellipse. This last method is the operation of the trammel.

7. The same things being given to find the curve, by another method by points, Fig. 8.

Draw DE parallel to CB, and BE parallel to CD; divide BC and BE proportionally at *g* and *f*, make CI equal to CD; draw I *g h* and *f h* D, and the point *h* will be in the curve. In the same manner may other points *m*, *n* be found. Perhaps to find the points *m*, *h*, *n*, it would be easier to some to divide the lines BC and BE each into the same number of equal parts.

8. The same things being still given to describe the representation with a compass, Fig. 9.

Take half the conjugate CD, which apply on the semitransverse from A to E; divide EC into three equal parts, and set one towards A from E to F; make CG equal to CF; with the distance FG describe an equilateral triangle FHG; produce HF to I, and HG to K, from H, with the distance HD, describe an arc IK; from G, with the distance GK, describe an arc KB, and with the radius IF describe an arc IA; and AIDKB will be the curve of the semiellipse required.

9. To describe the curve of a parabola, having the double ordinate AB, and abscissa CD given in position, Fig. 10.

Draw AH parallel to CD, and HD to AC; divide AC and AH in the same proportion at *e* and *f*; draw *e g* parallel to CD, and draw *f g* D, the point *g* is in the curve of a parabola. In the same manner all other points *h*, *i* are to be found.

10. To describe the curve of a hyperbola, having a double ordinate AB, and a diameter DE, given in position, Fig. 11.

Draw AF parallel to CD, and FD to AB; divide AC and AF, the former in *f*, and the latter in *g*, in the same proportion; draw *f h* E and *g h* D, and the point *h* will be in the curve. In the same manner all other points *i*, *k* are to be found.

Demonstration for the ellipse and hyperbola, Fig. 12, 18.

Let AB be the diameter, CD the ordinate, AC the abscissa, and K a point in the curve.
Draw KN and *g* M parallel to CD, cutting AC in N and M.

Then because of the similar triangles . . . . . BNK,BCG .... BN : BC, : : NK : CG
ANK,AM*g* ... AN : AM, or *g* E : : NK : M *g*, or CD
And by construction . . . . *g* E : DE, or CA : : CG : CD

Therefore by multiplication we have . . . . BN × NA : BC × CA : : NK^2 CD^2
A well known property of the ellipse.

For the parabola, Fig. 14.

By similar triangles ANK and AM*g* . . . . AN : AM : : NK : M *g*, or CD
By construction . . . . AM : AC : : CG, or NK : CD

By multiplication . . . . AN : AC : : NK^2 CD^2
The property of the parabola.

11. Upon a given straight line AB, to describe any regular polygon, Fig. 15.

Produce the side AB to H, on AH, as a diameter, describe the semicircle ACH; divide the semicircumference HCA into as many equal parts as the polygon is to have sides; draw BC through the second division; bisect AB at K, and BC at L; draw KI at right angles to AB, and LI at right angles to BC; from I, with the distance IA, IB, or IC, describe the circle ABCD, &c. to A, which will contain the side AB the number of times required.

12. To cut off the angles of a square ABCD, so as to form an octagon, Fig. 16.

Draw the diagonals AC and BD, intersecting each other at E; through E, draw FG and HI parallel to the sides; make EI, EG, EH, EF, each equal to any half diagonal ED; join IF, FH, HG, and GI, cutting the sides of the square at P, Q, R, K, L, M, N, O; join KL, LM, MN, NO, OP, PQ, QR, RK and KLMNOPQR will be the octagon required.

13. To inscribe an octagon in a square ABCD, having four of its angles in the middle of the sides, Fig. 17.

Draw the diagonals AC and BD, cutting each other at E; through E draw FK and HM parallel to the sides, cutting the sides of the square in the middle at F, H, K, M; make EG, EI, EL, EN, each equal to the half side of the square; join FG, GH, HI, IK, KL, LM, MN, NF, FG, and FGHIKLMN will be the octagon required.

14. To cut off the angles of an oblong ABCD, so as to form an elliptic octagon, Fig. 18.

Draw the diagonals AC and BD, cutting each other at E; draw FG and HI parallel to the sides; make FU and AK each equal to FA; and join UK and AU; make UM equal to UF; draw ML parallel to FK, cutting AD at L; make FT equal to FL, and GP and GQ each equal to FL; draw LN and QR parallel to DB; PO and TS parallel to AC; then will LNOPQRST be the elliptic octagon required.

15. In a given oblong ABCD to inscribe an elliptic octagon, Fig. 19.

Draw the diagonals AC and BD, cutting each other at E; make IK equal to IB, and join KB, cutting FG at L; make EM equal to LB, and EN equal to KB; OG, GR, RH, HQ, QF, EP, PI, IO, and OIPFQHRGO will be the elliptic octagon required.

16. Through a given point K, to draw the circumference of an ellipse concentric with a given ellipse ABCDEFGH, Fig. 20.

Let I be the centre; take any number of points A, B, C, D, E, F, G, H, in the circumference of the given ellipse; draw the semidiameters AI, BI, CI, DI, EI, FI, GI, HI, and the chords AB, BC, CD, DE, EF, FG, GH, HA; parallel to these draw KL, LM, MN, NO, OP, PQ, QR, meeting the semidiameters, and through the points KLMNOPQR to K draw a curve, which is the ellipse required.

17. About a given rectangle ABCD, to circumscribe an ellipse which shall have its axis parallel to, and in the same proportion as the sides of the rectangle, Fig. 21.

Draw the diagonals AC and DB, cutting each other at N; through N draw EF and GH parallel to the sides of the rectangle; produce GH to K, making IK equal to IA, or IB; join KA and KB; from K, with the distance KI, describe the arc LI, cutting KA at L; draw LM parallel to HG, cutting AC at M; join MO and MI; draw AH parallel to MI, and AE parallel to MO; make NF equal to NE, and NG equal to NH: then EF is the transverse axis, and HG the conjugate, by which the required ellipse may be described.

18. To find the figure of the sines to any given height, Fig. 22.

Describe a semicircle ABC, to a given height; divide the quadrant AB into any number of equal parts by the points 1, 2, 3; make D *e* equal to A 1, D *f* equal to A 2, D *g* equal to A 3, and D H equal to AB; draw the ordinates *ci*, *fk*, *gl*, HI, also the ordinates or sines to AC;

make *cl*, *fk*, *gl*, HI, respectively equal to the sines. In the same manner may the half figure QRS be found, by taking the ordinates of the ellipse for the ordinates of the semicircle.

This Figure is very frequently required in architecture. The coverings of cylinders, and domes of every species, are of this form. It may be drawn to any given proportion, by dividing a quadrantal arc into any number of equal parts, and the half base into the same number of equal parts, and taking the sines as ordinates in the Figure.

19. To construct a trapezium equal and similar to a given trapezium, Fig. 23.

Let No. 1. be the given trapezium, which divide into two triangles ABC, ACD, by a diagonal AC; make the triangle ABC, No. 2. equal to the triangle ABC, No. 1. (Euclid, book i. prop. 23.); and the triangle ACD, No. 2. equal to the triangle ACD, No. 1; then will the trapezium ABCD, No. 2. be equal to the trapezium ABCD, No. 1.

In this manner may any rectilineal figure be made equal and similar to any other given rectilineal figure, by resolving the given figure into triangles, and constructing these one after the other in the successive order of their contiguity, until all the triangles of the original figure have been constructed in the required figure, and the result will be a polygon equal and similar to the given figure.

20. To construct a rectilineal figure similar to a given rectilineal figure ABCDEFGHA, Fig. 24. having one of the sides of the required figure corresponding to a side of the given figure.

Make A *b*, No. 1. equal to the side of the required figure corresponding to AB, the side of the given figure; draw the diagonals AC, AD, AE, AF, and AG; make *bc*, *cd*, *de*, *ef*, *fg*, and *gh*, respectively parallel to BC, CD, DE, EF, FG, and GH, from one diagonal to the other. By the last problem construct the rectilineal figure *abcdefgha*, No. 1. similar and equal to the rectilineal figure *Abcdefgh*A, No. 1.; and *abcdefgha*, No. 2. will be equal and similar to ABCDEFGHA, No. 1.

By means of these problems, it will be easy to adapt a piece of framing to any place required.

21. Given two lines AB, CD, inclining towards each other, to draw a line from a given point A in one of them, so as to make equal angles with both lines, Fig. 25.

Through A draw EF parallel to CD; bisect the angle BAF by AC, and the angles BAC and DCA will be equal.

BOOK II.

Stereographical Principles of Carpentry.

Stereography is that branch of knowledge which demonstrates the properties, and teaches the whole doctrine of regularly defined solids. It explains the rules for constructing the superficies in plano, so as to form the entire solid, or to cover its surface. It also shews how to form any section thereof, or to find any angles or inclinations relating to two or more of its surfaces; or any angles upon any one of its surfaces, formed by a sectional line and adjacent side of the surface, by having the proper data given according to what may be required.

Mr Hamilton has denominated the principles of perspective by the term *stereography*, contrary to the usage of other authors. Perspective is only a branch of the doctrine of solids; and all that this branch teaches, is only the methods for finding the sections of pyramids and cones, the eye being considered as the vertex, the original object the base of the pyramid or cone, and the picture to be drawn a section thereof; the term is therefore of too general application, perspective being only a branch of stereography.

The eleventh and twelfth books of the *Elements of Euclid* belong to stereography: these may be looked upon as the theory of the doctrine of solids, and to them we shall refer our readers for the original properties; but for their practical applications to useful properties in life, it is rather singular that so little has been done in this respect. The present article is entirely new. It is of the greatest importance in the various mechanical departments of architecture. The geometrical principles in masonry, carpentry, joinery, and the other useful branches of the building art, are entirely dependent upon it: in short, the cutting of individual pieces of timber in the art of carpentry, and the formation of separate stones in masonry, is only the application of stereography to practice.

To the acquirement of these arts this branch of geometry is therefore indispensible; and, as it is a key to the whole, no farther apology for its introduction is necessary.

DEFINITIONS OF SOLIDS, AND THEIR PROPERTIES.

A prism is a solid, the ends of which are similar and equal parallel plane figures, and the sides parallelograms; and if the ends of the prism are perpendicular to the sides, the prism is called a right prism, but if otherwise, it is termed oblique: If the sides and ends are equal squares, the prism is called a cube; and if the base or ends are parallelograms, the prism is called a parallelopiped: If all the planes of the parallelopiped are at right angles to each other, then the prism is called a rectangular prism: If the ends of the prism are circles, the prism is called a cylinder; but if they are ellipses, it is called a cylindroid.

All the sections of a cylinder, or cylindroid, are either circles, ellipses, or parallelograms, excepting when cut partly through the sides, and partly through the ends, and then they are portions of circles or ellipses.

All parallel sections of a prism are equal and similar polygons.

All sections whatever, except partly through the base, and partly through the sides of a parallelopiped, are parallelograms.

All sections of a cylinder, or cylindroid, through the curved surface, are either ellipses or circles; and all sections parallel to the axis are parallelograms.

A solid having any plane figure for its base, and its sides triangles, meeting in a common point, is called a pyramid; and this point is called the vertex of the pyramid. A pyramid is denominated triangular, square, pentagonal, hexagonal, &c. If the base be a circle, the pyramid is called a cone.

The axis of a cone is a straight line, extending from the centre of the base to the vertex.

Properties.

All parallel sections of a pyramid are similar figures, except they be parallel to a plane within the pyramid, passing through the vertex.

All sections through the vertex within the pyramid are triangles.

All sections of a cone parallel to the plane, passing through the vertex without the cone, but not parallel to the base, are ellipses.

All sections of a cone parallel to the base are circles.

All sections of a cone parallel to a plane touching the curved surface are parabolas.

All sections of a cone parallel to a plane within the cone, passing through the vertex, are hyperbolas.

The frustum of a pyramid, or cone, is that which is left by cutting away the part which contains the vertex by a plane parallel to the base.

An ungula of a pyramid, or cone, is that which is left by cutting away the part which has the vertex, by a plane not parallel to the base.

A Cunius is a solid, the base of which is a rectangle, and the four sides joining the base plane surfaces; two are triangles, and the other two parallelograms.

The *cunioid*, or *cono-cunius*, is a tapering solid, such that the base is a circle, or ellipse, and the vertex a straight line, parallel and equal to the diameter of the base; the curved surface such, that if a plane be supposed to pass through the middle of the vertex and the centre of the base, and a straight line be continually applied while in motion to the circumference and the vertex, so as always to be parallel to the plane, until the straight line so applied has gone entirely round the circumference of the base.

Properties.

All sections of the solid parallel to the plane, as well as that in the plane, are triangles.

All sections passing through the vertex are parallelograms.

All sections parallel to the base are ellipses, except one, which is a circle.

If the vertex be in a plane, passing through the centre of the base, perpendicular to the said base, and the straight line drawn from the centre of the base to the middle of the vertex be also perpendicular to the base, the cunioid is said to be right, but, if otherwise, oblique.

A Prismoid is a solid, terminated by two dissimilar rectangular ends, and the remaining surfaces joining the ends planes.

Properties.

All parallel sections cutting entirely through the sides, are quadrilaterals.

All sections parallel to the bases have their corresponding angles equal, but the corresponding sides of these angles disproportional.

A Sphere is a solid, such that all lines drawn, or conceived to be drawn, from a certain point within the solid to the surface, are equal.

Property.

All the sections of a sphere are circles.

A Spheroid is a solid, formed by the revolution of a semi-ellipse about one of the axes.

If the spheroid be generated round the greater axis, it is called an oblong or prolate spheroid.

If the spheroid be generated round the lesser axis, it is called an oblate spheroid.

Prob. I. Given the altitude of any three points above a plane, and the seats of the three points on that plane, to find the intersection of another plane passing through the points, with the plane which contains the seats of the three points. Plate CXV. Fig. 1, 2, 3.

Let A, B, C be the seats of the three given points. Join any two points A and C; draw AD and CE each perpendicular to AC; make AD equal to the height of the point on A, CE equal to the height of the point on C, and join ED; produce ED and CA to meet each other at I; make CF on the line CE equal to the height on B; draw FG parallel to CA, cutting ED at G; and draw GH parallel to EC, cutting AC at H; join HB, and draw KIL parallel to HB,—then will KL be the intersection required.

In Fig. 1. the distance CF is greater than AD, but less than CE; this makes the point G fall between the points D and E, and the point H between the points A and C. In Fig. 2. CF is greater than CE; this makes the point G fall on DE produced, and the point H on AC produced. In Fig. 3. HG is less than AD, which makes the point G fall between D and I, and the point H between A and I.

These three diagrams are particularly useful in the covering of solids, in the sections of cylinders and prisms, and in the finding of the face moulds for the hand rails of stairs, and in groins where the planes of the angle ribs stand at oblique angles to the plane, and where the section passes through three given points. Fig. 1. and 2. are also useful in the sections of solids, when the angle which the vertical side makes with the inclined side is given.

Solid Angles.

Of the Construction of Solid Angles, consisting of any three Plane Angles.

In these, besides the three plane angles, there are also to be considered the three inclinations of the planes; so that in a solid angle there are six parts, any three of which being given, the other three may be found. Solid angles are either right angled or oblique: when they are right angled, two of the planes form a right angle with each other; and this is the only case necessary to be considered, as all the cases of oblique solid angles can be solved by the help of those which are right angled. The planes containing the right angle are called legs; the plane subtending the right angle, the hypothenuse; and the three inclinations, angles.

Prob. II. In a right angled solid angle are given the two planes ABC and ABD, containing the right angle to find the hypothenuse, and the angle contained by the hypothenuse and the leg ABD. (Fig. 4.)

In AB take any point A; draw AC at right angles with AB, and ADE at right angles with BD; make BE equal to BC, and BE will be the hypothenuse; from AB cut off AF equal to AD, and join FC, and AFC will be the angle required.

For if the plane ABD be raised upon AB, at a right angle with the plane ABC, and the plane ACF turned up on AC until AF coincide with AD, and, lastly, the plane DBE turned round the line DB until BE fall upon FC; then BE will fall upon BC, FA and FC will be at right angles to BD, and consequently AFC will be the inclination of the planes.

Prob. III. Given one of the legs, and the angle opposite, to find the other leg. (Fig. 5.)

Let ABC be the given leg; make ADC equal to the given angle; from the point C draw CA at right angles with AB; from A, with the radius AD, describe the arc DE, and draw BE a tangent to the arc at E; then will ABE be the other leg required.

By these problems, the various levels in roofing are ascertained, as the backing of the hips, and the side joints of purlins and jack rafters; and in hand-railing, the spring of the plank, and the intersection of the plane of the plank with a horizontal plane.

Prob. IV. In a right angled solid angle, consisting of three plane angles, are given one of the legs and the adjacent angle to find the hypothenuse. (Fig. 6.)

Let ABC be the given leg; from any point A draw AD perpendicular to AB; make the angle DAE equal to the adjacent angle; from A, with any radius AD, describe an arc DE, cutting AE at E; draw DF and EC parallel to AB; and draw CF parallel to AD, and join F, B, and FBA will be the hypothenuse.

Prob. V. In an oblique angled solid angle, consisting of three plane angles, are given one of the sides, and the two adjacent angles, to find the other side. (Fig. 7.)

Let ABC be the given side; in AB take any point A, and draw AD perpendicular to AB; make the angle DAE equal to one of the given angles; draw EK and DL parallel to AB, the former cutting AD at M, any where in CB, or in CB produced take any point F, draw FG perpendicular to CF, and make the angle GFI equal to the other given angle; produce CF to H, and make FH equal to ME; draw HI parallel to FG, IK parallel to BC, and KL parallel to AD; join BL, and ABL is the side required.

The applications of these problems are numerous, in cutting timbers to fit at any angle against another; likewise in oblique stone arches, which have cylindric or cylindroidic intradoses, in cutting the sides of the bevels of the stone to the given angles. In these, a series of bevels may be found, which will have one side common, while the other side of each is only varied in the most easy manner. If the arch stand in a vertical wall, the constant angle will be a right angle; but if otherwise, it will be acute or obtuse: Thus, suppose AB, Fig. 8. to be the line of an erect wall upon the ground, and CD the direction of the arch; or, let AB be the intersection of any plane, and CD the direction of a prismatic piece of timber, consisting of several sides, to be cut so as to fit against the plane: Suppose ECF, ECG, ECH, &c. to be the angles which the several beds make with each other, in a plane perpendicular to the sides of the arch, or the angles which a series of planes would make at the same intersection, parallel to the sides of the same prism; then CD*f*, CD*g*, CD*h*, &c. are respectively the angles which two adjoining sides of the beds make with each other, or the angles which the several arrises of the prism make with the sides of the end to be cut. In like manner, Fig. 9. shows a series of angles when the plane inclines or reclines; each is to be found in the same manner as in Fig. 7. the angles DC*f*, DC*g*, DC*h*, &c. corresponding with EDF, EDG, EDH, &c. In Fig. 8. it will be only necessary to find the angles on one side; but in Fig. 9. they must be found on both sides.

Prob. VI. The base and one of the planes of a prism being given, to find the section of the prism oblique to the base, but at right angles to the plane of the side given, the line of inclination being given in position upon the given side of the prism.

Place the base contiguous to the given side of the prism, so as to join to their common side, or line of concourse, or line of junction; take as many ordinates in the base as may be thought sufficient, and produce them to the line of inclination; from the intersected points in the line of inclination draw perpendiculars, which make equal to their corresponding ordinates in the base; and if the points in the base where the lines proceed are the junctions of straight lines, join every two adjacent points by straight lines, and the section will be formed; or, if the points proceed from a curve, a curve must be traced through the points found in the section.

Examples. In Plate CXVI. Fig 1. the base ABCD being a rectangle, the two sides AE and BF of the given plane in a straight line with AD and BC, two of the sides of the base answer the purpose of ordinates, and therefore we have only to complete the section to the length of the inclination EF, and to the breadth BC or AD of the base.

In Fig. 2. the base is bounded by several straight lines, and therefore every two contiguous points in the section are also joined by straight lines.

In Fig. 3. the base is the arc of a circle, therefore the remaining boundary of the section must be a curve passing through the several points: The section here is the segment of an ellipse.

Prob. VII. To find the section of a prism, the base and one of the adjoining planes being given, also a sectional line on the given plane, and the angle which the common side makes with the line of intersection of the prism.

Produce the line of concourse BA. (Fig. 4.) and the sectional line CD, till they meet in E; make the angle BEF equal to the angle which the section line is to make with the line of concourse; from any point F in EF draw FG perpendicular to EB, cutting EB in G, and GH perpendicular to EC, cutting EC at I; from E, with the distance EF, describe an arc cutting GH at H, and join EH; in the boundary of the base take any point *k*; draw *k l* parallel to EF, cutting AB, or AB produced at *l*; draw *l m* parallel to the side BC of the plane, cutting CD at *m*; draw *m n* parallel to EH; make *m n* equal to *l k*, and *n* will be in the boundary of the section required: In the same manner all other necessary points are to be found.

Examples. In Fig. 4. the base being a rectangle, the determination of the point *n* corresponding to one of the angles is sufficient; for being joined to the point C in the opposite side, two contiguous sides of the section will then be formed: The whole section will be inclosed by drawing the other two sides parallel to these sides.

In Fig. 5. the base consists of straight lines, and therefore the ordinates are taken from the angles, and the points found in the section joined by straight lines.

In Fig. 6. the base is wholly a curve, excepting the line of concourse; therefore drawing a curve through the points found in the section completes the boundary or inclosure.

CONIC SECTIONS.

Prob. VIII. To find the section of a cone cut by a plane at any given inclination to the axis, or in a given position to the sides of the cone, Fig. 7. and 8.

Let ABC be a section of the cone through the axis, ABD the half base, and let MN be the position of the axis of the section, in respect to the side AB of the cone; now, to find any point in the curve, take any point D in the circumference of the base; draw DE perpendicular to the diameter AB, cutting it at E, and EC cutting MN at g; draw gh parallel to AB, and gi perpendicular to MN; make Ef equal to ED; draw fhC, make gi equal to gh, and i is a point in the curve. In like manner all other points k and l are to be obtained, and thus the curve may be completed by tracing it through the points.

In Fig. 7. MN, the axis of the section, cuts the other side BC of the cone; and the section produced from this position is an ellipse. In Fig. 8. the axis MN is parallel to the side CB of the cone; and the section produced is therefore a parabola. In the same manner the hyperbola may be found; it is only fixing upon the position of the axis.

CUNIOIDAL SECTIONS.

Prob. IX. To find the section of a cunioid cut by a plane perpendicular to the axal triangle. (Fig. 9.)

Let ABC be the axal triangle, ADB the half base, MN the axis of the section. In the circumference of the base take any point D; draw DE perpendicular to AB, cutting it at E; join EC, cutting MN at f; draw fg perpendicular to MN; make fg equal to ED; and g, h, i, k, &c. are obtained.

Prob. X. To find the section of a cunioid, cut obliquely to the axal section ABC, through two given points X, Y, on the sides of the axal triangle, and any point on the surface, the seat of which being given on the axal section at Z. (Fig. 10.)

Draw CZD, cutting the diameter of the base at D; draw DE perpendicular to AB, cutting the circumference at E; join XY, and draw FZG parallel to XY, cutting AC and BC at F and G; draw FH perpendicular to FG; produce XY to K; make KH equal to DE, and draw HI parallel to KY or FG. To find any point in the curve, from any point L in the circumference of the base, draw LM perpendicular to AB, cutting AB at M; join MC, cutting FG at o, and XY at n; make Hp equal to Fo; join pn; make Kq equal to ML, and draw qr parallel to XY, cutting pn at r: then r is a point in the curve. In the same manner all other points s, t, u, &c. are found.

The following is a general method of finding the sections of all solids, the surfaces of which are formed by straight lines constituted according to any given law. When cut by a plane, the intersection and inclination of which are given to the plane of the base of the solid; also the inclination of the axis, and the seat on the said base, in position to the intersection.

In the consideration of this subject, there are three angular planes concerned. Two of these are perpendicular to each other; and the third joining the other two, forms a right angled solid angle, the last plane being the hypothenuse, and the former two the legs. The base of the object, the section of which is required, is given on one of the legs, and this plane is called the original plane, and all lines drawn in it whatever are called original lines. The hypothenusal plane is that which forms the section, and is called the plane of projection, or sectional plane. The third plane, which is the remaining leg, is called the directing plane. The directing plane is always parallel to the axis, or principal elevated line of the solid. The section of the solid is likewise called the projection. In finding the projection or section, the sides of the solid angle are all extended on the same plane. The line of concourse of the original and projecting planes is called intersection. As the two sides and hypothenuse are in contiguity when spread out on a plane, the side of the original plane, and the projecting plane which join each other, will be separated, that is, what has been called the intersection; to distinguish the one from the other, the side of the original plane which meets the projecting plane is called the intersection, and the side of the projecting plane which meets the base the co-intersection. The intersection of the vertical plane with the original plane is called the director; and the intersection of the plane of projection, and the directing plane, is called the directing line. Thus in Plate CXVII. Figs. 1, 2, 3, 4, ABC is denominated the original plane, ABD the directing plane, DBE the sectional plane, or plane of projection, or projecting plane; CB is termed the intersection, AB the director, DB the directing line, and BE the co-intersection.

If the object, the section of which is required, be a pyramid or cone, and a plane be supposed to be drawn through the vertex parallel to the base, until it intersect the projecting plane, the line of intersection is called the vanishing line.

The inclination of the sectional plane and the intersection, and the seat of the inclination of the object, the section of which is required, being given, the director AB may be any line parallel to the seat of inclination. To determine the directing plane and the sectional plane, proceed in Fig. 3. thus: Let ABC be the original plane, BC the intersection, AB the director. From any point C in BC, draw CA perpendicular to BC, and Ag perpendicular to CA. Make the angle ACg equal to the inclination of the sectional plane. Draw AD perpendicular to AB, equal to Ag, join DB, and ABD is the directing plane. From B, with the distance BC, describe an arc at F; and from D, with the distance gC, describe another arc, cutting the former at F. Draw BF, and DBF is the sectional plane.

In the projection of solids in general, the nature of the solid, or its elementary construction, must be considered. Suppose the solid to be a pyramid or cone, and a plane to pass through its axis until it meet the directing plane, the original plane, and the plane of projection. Place the height of the pyramid on the line where this plane meets the directing plane, and let this line be called the director of the axis. Let a line be supposed to be drawn from the upper end of the director of the axis to the vertex of the pyramid or cone; this line will be parallel to the original plane, and in the same plane with the line formed on the original plane, by the aforesaid plane passing through the axis. Suppose any number of planes to pass through this line, to any number of points in the base of the solid, to cut the original plane, the directing plane, and the sectional plane; the intersections of the several planes thus drawn, will form parallel lines on the original plane, converging lines from the intersections of the parallel lines to the summit of the directing axis, and lines will also be formed on the sectional plane, meeting the parallels on the original plane at the intersection at one of their extremities, and the converging lines at the points where they meet the directing line at the other extremity. The planes which thus generate these three sets of lines, will cut the surface of the solid in straight lines passing through its vertex. Again, if there be taken another directing axis, and another set of planes be supposed to pass through the line which extends between the apex of this axis and that of the pyramid or cone, and through the several points taken before in the base of the object, three other sets of lines will be formed in the same manner, and will cut the sides of the pyramid or cone in the same intersections as at first: also the last set of lines in the plane of projection will intersect the former in the very same points, as lines drawn from the several points in the base of the object before taken to its vertex. If the section required be that of a prism, draw the plane parallel to the inclination of the prism, instead of planes intersecting each other on the line joining the apex of the pyramid or cone, and the top of the apex line. The following problems, in particular examples, will illustrate these general descriptions and definitions.

Prob. XI. To find the section of a pyramid, placed with one of its sides parallel to the intersection. Plate CXVII. Fig. 1.

Let the parallelogram IFGH be the base of the pyramid, with the sides FI and GH parallel to CB; draw the diagonals GI and FH intersecting at K, and produce FG and IH to the intersection at O and Q, and draw KP parallel to them, meeting the said intersection at P; make B*q*, B*p*, B*o*, respectively equal to BQ, BP, BO; produce FI and GH to cut AB at M and N, and draw KL parallel to them, cutting AB at L; draw LR, making an angle with AB equal to the angle which the axis or line from K to the vertex makes with the plane of the base; make LR equal to the length of the said axis; draw RD parallel to AB, cutting BD at D; draw TDU parallel to BE, then LR will be the director of the axis, and TU the vanishing line; draw M*m*, L*l*, N*n* towards R, cutting BD at *n*, *l*, *m*; also draw *m i f*, *l k*, *n h g* parallel to BE; make L*k* equal LK; draw *p k*, and produce it till it meet TU at S; draw *o g f* S and *q h i* S, and *f g h i* will be the projection of FGHI, or the section of the pyramid, the base of which is FGHI. The reason why *m i f*, *l k*, *n h g* are drawn parallel, is, because that any section made by a plane through any line on the original plane, parallel to the intersection, will cut the sectional plane also parallel to the intersection.

Prob. XII. To find the section of a pyramid, when the base stands at oblique angles to the intersection. Fig. 2.

Let the rectangle FGHI be the base; produce IH and FG to Q and S; FI and GH to N and P in the intersecting line; through K, draw LR parallel to FG or IH, cutting AB at L; and CB at R; also through K, draw KM parallel to the intersection CB, cutting AB at M; draw M*m*, making the same angle with AB as the axis makes with the original plane. Draw *m k* parallel to BE; make *m k* equal to MK; draw KO parallel to FN, cutting CB at O; make B*n*, B*o*, B*p*, B*q*, B*r*, B*s*, each respectively equal to BN, BO, BP, BQ, BR, BS; draw *r k* and *o k*; draw L*u* parallel to M*m*, and make L*u* equal to the length of the axis of the pyramid; draw *u*D parallel to AB, cutting BD at *D*, draw VW parallel to BE; produce *r k* and *o k* to V and W; draw *s g f* V, *q h i* V, also *p h g* W, *n i f* W: Then will *f g h* be the section of the pyramid required.

From what has been now said, Figs. 4. and 5. will be understood, and may be described in the same words as in Fig. 1; only it is to be observed, that the different points in a cone are formed in the same manner as the angles, and as many as may be thought necessary for tracing the curve. Fig. 4. shows the section when the axis of the cone stands perpendicular to the plane of the base; and Fig. 5. for a cone which has its axis inclined to the base.

Prob. XIII. Given the seat D of the vertex, the intersection AC of a triangular plane, also the intersection EF of a cutting or sectional plane in position to one another, likewise the altitude of the vertex above its seat, and the inclination of the cutting plane; to find the line of section on the triangular plane, provided that the angle of the cutting plane is small enough to admit of an intersection with the triangular plane. Plate CXVII. Fig. 5.

Draw DG perpendicular to EF, cutting EF at G, and draw DH perpendicular to DG, make the angle DGH equal to the inclination of the cutting plane; produce GD to I; make DI equal to the perpendicular altitude of the triangle; produce HD to meet AC in K; join KI; draw DB perpendicular to AC; from K, with the distance KI, describe an arc cutting DB at B, and join BA, BC, and BK; make DL equal to DH; draw LM parallel to DK, cutting KI at M; from KB cut off KN, equal to KM, and produce CA to E; draw ENO, cutting BC at O, then OP is the section required.

Prob. XIV. The seat A of the vertex and base BCDE of a rectangular pyramid, and the intersection FG, of a sectional plane being given in position, and the height of the pyramid in quantity, to determine the lines of section made on the sides of the pyramid by the sectional plane. Fig 6.

Proceed as in the last problem, and find the section of each triangle, which will be the same as the sections of the sides of the pyramid required. It may here be observed, that one triangle HKI will serve for the whole, instead of DIK, and the two sides BE and DC, which do not meet HI, must be produced till they meet it, and all the intersections must be drawn to K, as in Fig. 5.

Prob. XV. Given the base ABCDEFA of an erect prism, and the intersection HI of a sectional plane, and the inclination of this plane, to find the sectional lines on the sides of the prism. Fig. 7.

Draw lines GH, GL, and GI, parallel to the sides of the prism, till they cut the intersecting line; draw GK perpendicular to HI, meeting it at K, and GP perpendicular to GK; make the angle GKP equal to the inclination; make GM, GN, GO, each equal to GP; draw MH, NL, OI, and GMH, GNL, GOI, are the angles which the sectional lines make with the lines of concourse of the angles.

From what has now been said, Fig. 8. will be plain to inspection. It only differs from the last, in the base being a square.

Prob. XVI. Any three points being given on the surface of a cylinder, to find an envelope that would coincide with a section passing through these three points, and over the surface of the segment of the cylinder, between the two straight lines drawn on the surface, through the two most remote points parallel to the axis, the seat of the three points being given on the base. Plate CXVIII. Fig. 1.

This will admit of three different cases. Let Fig. 1. be the cylinder, and let the points be B, D, F; draw BA, DC, and FE parallel to the axis cutting the base at A, C, E; then A, C, and E are the seats of the three points, and ACEFDBA is the portion which requires the envelope.

Now, suppose the cylinder to be cut by a plane ABFE, which will be parallel to the axis, besides the plane of the section BDFGHI; then the plane ABFE may cut the plane of the section through the three points at right angles, or the plane ABFE may form an acute angle with the plane BDFA, or any obtuse angle with the said part, according to the situation of the point D.

In the general description, it will only be necessary to have the seats of the three points given on the base, and the heights of the points on the cylinder from their seats. Let ABC, Fig. 2, 3, 4, be the part of the base of the cylinder, and A, B, C, the seats of the three points. Join AC; draw CE and AD perpendicular to AC; make AD equal to the height of the point above A, CE equal to the height of the point above C, and CF equal to the height of the point above the seat B; join ED; draw FG parallel to CA, and GH parallel to EC or DA, cutting AC at H, and join HB; produce AC to I; divide the curve ABC into any number of equal parts, and extend these parts upon CI; through the points of division in the curve ABC, draw lines parallel to BH intersecting AC; from the points of intersection in AC, draw lines parallel to GH to meet DE; from the points of meeting in DE, draw lines parallel to AC; and from the divisions in CI, draw lines parallel to CE, so as to intersect the other parallels last drawn, the one continually nearer to CI and more remote from CE than the last, and draw a curve EK through the several points, and CIKEC will be the envelope required.

Fig. 1. is the case where the rectangular plane makes a right angle with the elliptic section; Fig. 2. that where the angle made by the rectangular plane and the elliptic section is acute; and Fig. 3. the case where the angle formed by these two planes is obtuse.

In Fig. 3. and 4. DME is the orthographical projection of the curve, with which the curve line EK of the envelope would coincide: This is found by drawing parallels to GH through the points of division in the curve ABC, to meet the parallels of AC, as shown by the dotted lines.

Coverings of Solids.

Prob. XVII. To cover any portion of the surface of a cylinder, cut by any two oblique planes at right angles to an axal plane, given the inclination of the cutting plane to the axis; so that the envelope, or covering, will exactly cover the surface of the cylinder terminated by the sections.

Let that part of the axal plane intersected by the two oblique sections, and one or both sides of the cylinder, be denominated the seat of the envelope; and suppose the cylinder, or portion of the cylinder, to be cut by a plane at right angles to the axis, the intersection of this and the axal plane will either fall within the seat of the envelope or its plane produced; again, let the arc of the section at right angles to the axis, be called the regulating arc; the section itself, the regulating section; the base of the said section on the axal plane, the primary abscissa; and the regulating arc extended in a straight line, the secondary abscissa; and all lines at right angles to the primary abscissa, terminated by the sides of the seat of the envelope, ordinates.

The method of finding the envelope will then be as follows: Take any convenient straight line for the primary abscissa as a base, and describe the regulating section; describe the seat of the envelope in position to the primary abscissa; divide the regulating arc into any number of equal parts; extend the parts on any convenient straight line for the secondary abscissa; draw lines through the points of division in the regulating arc, at right angles to the primary abscissa, so as to cut both sides of the seat of the envelope; through the points of division, in the secondary abscissa, draw lines at right angles to the said abscissa; then taking the ordinates of the primary abscissa, and placing them from the secondary abscissa on the indefinite perpendiculars, their extremities will give the points through which the curves or sides of the envelope will pass.

Examples. Let ABCD, Fig. 5. No. 1, represent the quarter of a cylinder ABE, a section at right angles to the axis projected on a plane, orthographically, with its axis parallel to the said plane; let the right angled triangle AB*f* represent a part to be covered. In this case, AB and B*f* form a right angle; make ABC, No. 2, equal to AB*f*, No. 1; then ABC will be the seat of the envelope, AB the primary abscissa, and also a side of the seat of the envelope. Make ABD the regulating section of the quadrantal cylinder; divide the regulating arc BD into any number of equal parts; from the points of division draw lines perpendicular to AB; continue these lines to meet AC; take the equal parts of the arc BD, and extend them on the secondary abscissa BE; draw indefinite perpendiculars to BE; take all the ordinates from the seat of the envelope, beginning with BC, and place them respectively on the indefinite perpendiculars from the secondary abscissa BE, and through the extremities draw the curve CE, then will BEC be the envelope required.

Let the obtuse angled triangle, *d e f*, No. 1. represent the part to be covered: make AFC, No. 3. equal to *d e f*, and AFC is the seat of the envelope: produce CF to B, and draw AB, forming a right angle with BC. Upon AB describe the regulating section ABD: divide the arc BD into any number of equal parts: from the points of division draw perpendiculars to AB: produce the perpendiculars to meet AC: extend the parts of the arc BD upon BE: from the points of division draw the indefinite perpendiculars: take the ordinates from the seat of the envelope contained between AB and AF, beginning the first with BF, and apply them respectively as ordinates to BE. Again, take the ordinates in the seat of the envelope contained between AB and AC, beginning with BC, and apply them respectively as ordinates to BE. Through the extremities of the first set of ordinates, draw the curve FE; and through the extremities of the second set, draw the curve CE; then will FCE be the envelope required.

Again, let the acute angled triangle, *g h i*, No. 1. represent the part to be covered: it may be shown in the same words, and by the same letters of reference, that FCE, No. 4. will be the envelope for the surface *g h i*, No. 1.

In the same manner, it may be shown, that FEHC,

Fig. 6. No. 2. is the envelope for that part $e f g c$. Fig. 6. No. 1. of the semicylinder ABCD, BE being the stretch out of BDA, and AFCG the seat of $f g$ C e.

Nothing can be more useful in geometrical lines than the method of describing the envelope of any portion of a cylinder. By this method we are enabled to describe the soffits of the intradoses of any arched aperture; to find the exact situation of a line on the curved surface of any rib line that would stand vertically over any given line as a seat, whatever be the form of the line which constitutes the seat. The covering of domes with boards is exactly the same as in Fig. 5. No. 4. The dome, even though spherical, may be supposed to be constituted of a number of cylindric pieces, each forming an isosceles triangle on the base. In this case, the part to be covered will be contained between two oblique planes, making equal angles with the axis of the cylinder: the quadrant ABD may be considered as a section of the dome through the axis; and the envelope CEF one of the boards, which, when found, is a mould for all the rest. Having a clear understanding of these several diagrams, it cannot be difficult to form an idea how to cover any portion of a cylinder, whether bounded by parallel planes or by any curved section whatever. The falling moulds of the hand rails of stairs are to be considered as the envelope of certain portions of cylinders.

Prob. XVIII.—To cover the surface of a semicylindroid, contained between two parallel planes, given the regulating section and the seat of the envelope. Fig. 7.

Let the regulating section be ABC, and let CDEF be the seat of the envelope: divide the regulating arc ABC into any number of equal arcs: extend these arcs on the straight line AH: draw lines through the divisions of the arc ABC, at right angles to AC, producing them till they meet EF. Through the points of division in AH draw indefinite ordinates: take the respective ordinates contained between AC and DC, beginning with AD, and apply them successively from AD towards H; and through their extremities draw the curve DH. In like manner, take the ordinates contained between AC and EF, and apply them in the same order on the indefinite ordinates of AH, and draw the curve EG; then will DEGH be the envelope required.

Prob. XIX.—To cover the portion of the surface of a semicylinder contained between two other cylindrical surfaces, which have their axes passing through that of the semicylinder, and to the plane of the said semicylinder, Fig. 8.

The method of proceeding with this is exactly the same as in the former cases, and may be expressed in the same words. It may only be observed, that as the seat is alike on both sides, by finding one half of the envelope the other will be given.

Prob. XX.—To find the envelope for the frustum of a semicone, Fig. 9. Let ABCD be the seat of the envelope; AEB the end of the frustum or regulating section: continue AD and BC till they meet in F: from F, with the radius FA, describe the arc AH; and with the radius FD describe the arc DG: make the arc AH equal to the arc AEB, and draw HGF: then will ADGH be the envelope required.

For, suppose the semicircle AEB turned upon AB at a right angle with ABCD, and the envelope ADGH bent and turned upon AD, so that the arc AH may coincide in all points with the semicircle AEB, and HG with BC, the arc AH will have AB for its seat, and the arc DG will have DC for its seat: therefore ADGH will be the envelope for the seat ABCD, which is the axal section of the frustum.

Prob. XXI. To find the envelope for the portion of a semicone terminated by two cylindrical surfaces, which have their axes perpendicular to the plane of the semicone, and passing through the axis of the said semicone, Fig. 10.

Let ABCDEFA be the seat of the envelope: join AC, and draw GH a tangent to the arc FED, cutting AF and CD produced at G and H; then, by the last problem, find the envelope AIKGA to cover the frustum of the cone, whose seat is ACHGA: then having marked the equal parts on the quadrant AL, and the same parts on the arc AI, which will be double in number to that contained in AL, draw lines through the points of division in AL, at right angles to AC. From the cutting points in AC, draw lines to the centre M of the cone: likewise through the points of division in the circular arc AI, draw lines again to M: from the points in the arc AB, and from those in the arc FE intersected by the lines drawn to M, draw lines parallel to AC, to meet AM: from the points of meeting describe arcs from M as a centre, so as to intercept the first, second, third, &c. drawn from the divisions in AB to the point M, taken in the same order from A towards B, and from F towards E: through the points thus intercepted, draw the curves AN and FO; and AFON will be the half of the envelope. Make the other half NOPI similar by the same method, or any other; and AFOPINA will be the whole envelope required.

Prob. XXII. To find the envelope of the frustum of a semicunioid, Fig. 11.

Let ABCE be the seat of the surface to be covered; let DEC, the section of the lesser end, be a semicircle, that of the greater end a semi-ellipse, and each of the same altitude, or NE equal MF. Produce AD and BC to meet in G. To find any point t, in the envelope, proceed thus: In the semicircumference DEC, take any point p very near to the extremity D of the diameter DC; draw $p q$ perpendicular to DC, cutting it in q: join q G; draw GH perpendicular to AG; on GH make G s equal to $q p$; extend the arc D p; from D, with this extension as a radius, describe an arc at t; from s, with the distance G q, describe another arc, cutting the former at t. In like manner, by taking the point v very near to p, draw $v w$ perpendicular to DC, cutting DC at w; join G w; make G o equal to $v w$; extend the arc $p v$, and from t, with this extension, describe an arc at y; from o with the distance G w, describe another arc, cutting the former at y, and y will be another point in the curve. In this manner all succeeding points to the centre j will be found; so that D $t y$, &c. will be the curve, which will correspond with the semicircle DEC; join $s t$ and $o y$, and produce them to u and z; also produce G q and G w to meet AB at n and x; make $t u$ equal to $q n$, and $y z$ equal to $w x$; then draw the curve D $t y$, &c. to J, and the curve A $u z$, &c. to the middle, and this will complete one half of the envelope; the other half being joined upon the same base, and made equal and similar, will complete the whole envelope ADKLA.

To find the envelope of a part of a semicunioid, contained between two cylindric surfaces, having their axes perpendicular to the triangle passing through the axis of the cunioid, and intersecting that of the cunioid, Fig. 12.

Find the curve line $nopq$, which corresponds to the semicircumference of the semicircle, as in the last problem, the straight line $aiklm$ being a tangent, and parallel to the chord on the concave side; make all the distances bf, cg, dh, &c. respectively equal to in, ko, lp, mq, &c.; draw the curve $efgh$ and it will be the edge of the envelope, which will have $enopq$, &c. for its seat; and if fs be made equal to nv, gt equal to ow, hu equal to qy, and the curve $rstu$, &c. being drawn, will give the other edge of the envelope, which will have the arc $vwxy$, &c. for its seat.

These two last problems are exceedingly useful in all kinds of arched work that is circular on the plan, the intradoses of the arches splaying on the sides and level at the crown, particularly in sash work: but it is to be regretted, that no accurate method for finding the envelope has yet been discovered; every attempt to greater accuracy than the above has been foiled. There is one method, however, that will give the envelope, or veneer, exactly true, by the use of a centre, and describing the lines on its surface the same manner as in plans, then applying the equal distances from the seats from a graduated pole, which is the vertex of the cunioid, that is, by making the distances equal to pq, vw, &c. Fig. 11. or by drawing the equal ordinates on the ends of the centre, and joining the level lines, and taking all the distances from their seats.

BOOK III.

Constructive Carpentry.

Constructive Carpentry shows the principles and mode of combining individual pieces of timber into one complete frame, which shall form an essential part of a building.

The knowledge of this configuration depends on the properties of the several solids which are to constitute the whole, and must be sought for in the principles of Stereography, which we have already illustrated. The angular ribs of domes, groins, roofs, &c.; the art of hand railing, sashes, and archivolts with circular heads upon circular plans, depend principally on the sections of solids. By the coverings of bodies, the under sides of groined ribs and the front ribs of niches are formed to their plans; the falling moulds of winding stairs are adapted to the spiral line of the steps, and the archivolts of arches to the plans of the apertures. By the angles which the arrises make with the adjacent sectional lines, we are enabled to cut prismatic or pyramidal bodies, so as to fit any plane surface, whatever angle or angles the arrises, or any determinate line of the body, may make with the said surface; as in purlins, jack rafters, &c. These principles are not only essential to carpentry, but are equally applicable to the constructive parts of masonry; as in the formation of arches, so as to form their surfaces in the face of any wall, and to the surface of any given solid which shall be a centre for the said arch. In plumbing, the sheets of lead for covering domes are formed by the rules for the covering of solids.

VAULTING, GROINING, AND ARCHING.

A simple vault is an interior concavity, extended over two parallel opposite walls, or over all the diametrically opposite sides of one circular wall.

The concavity, or interior surface of the vault, is called the intrados.

The intrados of a simple vault is generally formed of the portion of the surface of a cylinder, cylindroid, or sphere, never greater than that of half the solid; and the springing lines of the coussinet, which terminate the walls from which the vault rises, are generally straight lines, parallel to the axis of the cylinder or cylindroid.

When the vault is spherical, the circular wall terminates in a level plane at top, from which the vault springs, and forms either a complete hemisphere, or a portion of the sphere less than the hemisphere.

Conical surfaces are seldom employed in vaulting, but when a conical surface is employed for the intrados of a vault, it should be semi-conic, with a horizontal axis, or the surface of the whole cone with its axis vertical.

All vaults which have a horizontal straight axis, are called straight vaults.

All vaults which have their axis horizontal, are called horizonal vaults.

A GROIN, is the excavation or hollow formed by one simple vault piercing another at the same height, such, that two geometrical solids being transversely applied one after the other; a portion of the groin may have been in contact with the first solid, and the remaining part in contact with the second solid, when the first is removed. The most usual kind of groining is one cylinder piercing another, or a cylinder or cylindroid piercing each other, having their axes at right angles.

A multangular groin, is that which is formed by three or more simple vaults piercing each other at the same height, so that if the several solids which form each simple vault be respectively applied, only one at a time, to succeeding portions of groined surface, every portion of the groined surface will have formed successive contact with certain corresponding portions of each of the solids

A rectangular groin, is that which has the axes of the simple vaults in two vertical planes, at right angles to each other.

An equi-angular groin, is that in which the several axes of the simple vaults form equal angles, around the same point, in the same horizontal plane.

The axis of each simple vault forming the intrados of a groin, is the same with the axis of the geometrical solids, of which the intrados of the groin is composed.

When the breadths of the cross passages, or openings of a groined vault, are equal, the groin is said to be equilateral.

ARCHES are also formed by one simple vault piercing another, after the same manner as groins.

Arches have various names, according to the surfaces of the two geometrical bodies, which form the simple vault.

A cylindric arch, is that which is formed by the intersection of one portion of a cylinder with another.

A cylindroidic arch, is that which is formed by the intersection of one portion of a cylinder with another.

A spheric arch, is that which is formed by the intersection of one portion of the sphere with another.

A conic arch, is that which is formed by the intersection of one portion of a cone with another.

The species of every arch, formed by the intersection of two vaults of unequal heights, is denoted by two preceding words, the former of which ending in *o*, indicates the simple vault, which has the greater height, and the latter, ending in *ic*, indicates the simple vault of the less height.

When an arch is formed by the intersection of two unequal cylindric vaults, it is called a cylindro-cylindric arch.

When an arch is formed by the intersection of a cylindric vault with a spheric vault, and the spheric portion being of greater height than the cylindric portion, the arch is called a sphero-cylindric arch.

When an arch is formed by the intersection of a cylindric vault with a spheric vault, and the spheric portion is of less altitude than the cylindric portion, it is called a cylindro-spheric arch.

When one conic vault pierces another of greater altitude, the arch formed by the intersection is called a cono-conic arch.

History of Groins.

The invention of groins must have been subsequent to that of simple vaulting, and has probably originated from arched passages, when it was necessary to occupy the whole height. At what time they were first introduced in architecture is uncertain: the remains of antiquity shew that they are of very remote date, which, however, cannot be traced beyond the times of Roman power and grandeur. Use or necessity was no doubt the occasion of their invention; but in process of time they were used as ornaments, and became fashionable at the decline of the empire. They are to be found in the amphitheatre at Rome, formed at the intersections of the radiating and elliptic passages. In the temple of Peace, and baths of Dioclesian, at the same place, instead of massive piers, they are supported upon columns, the most feeble of all supports, and which would be incapable to resist the lateral pressure of the arches, were it not for the auxiliary support of the walls immediately behind them at the sides and angles of the building.

Groins continued to be used at the decline of the Roman empire in ecclesiastic structures; and wherever grandeur or decoration was required, they were never omitted. They became the most principal ornament of the times, and formed the most conspicuous features in the edifices in which they were employed. At first they were used in the same manner as by the Romans.

In after times the groins were supported upon ribs which sprung from cylindrical or polygonal pillars, with capitals of the same form. This produced a necessary change in the figure of the vaulting, as the bottom of the ribs rise from the circumference of a circle, instead of the angles of a square, with its sides parallel to the walls; and as the spaces between and over the ribs were vaulted in a twisted or winding surface, so as to coincide in every part with a straight line, level between the ribs; the angles of the groined surface were thus very obtuse at the bottom, but diminished continually upwards, and ended in a right angle, at the summit of the ceiling. Afterwards, when the pillars were formed upon a square plan, diagonally placed with regard to the sides of the building, and decorated with vertical mouldings, or small attached columns, and the number of ribs increased, the first idea of fan work would be presented at the springing of the ribs. But in this the architects would soon perceive an incongruity of form in the surface: as it approached the summit of the vaulting, the ribs would be formed all of equal radii, and disposed around to support a concavity which might be generated by revolving a curve round an axis which was in the centre of the pillars; and being accustomed to groins meeting in lines crossing each other, it was natural to suppose they would at first permit the ribs to run out and meet each other, which would then be of unequal lengths. If the difference between the openings was not very great, the lines thus formed, by the meeting of the opposite sides of the vaulting, would not differ materially from straight lines, but would not be parallel to the horizon, as they would run upwards towards the centre of the groin; but this would depend on the angle formed by two opposite ribs in the same plane. Thus if the tangents formed at the vertex of the opposite curves contained an angle of 120 degrees, the apex line on the ceiling would form a curve, in receding from the vertical angles of the said ribs, of a very decided convexity; but in going progressively forward, the curvature would change into a concavity, and then would begin again to descend. The idea of intersecting the ribs thus disposed in vertical planes around a common axis, by circular horizontal ribs, was natural; and this again would generate another idea, of supporting the upper ends of the ribs by a circular ring, concentric with the axis of a pillar; and thus being done from four pillars, would leave a space inclosed by four convex arcs of circles. Nothing farther was required to complete this system of vaulting than to fill up the space, and the whole would be keyed together. In this manner, by slow and imperceptible changes, a species of vaulting was invented very different from that of the Greeks and Romans. Instead of closing the space, if we suppose another ring forming a complete circumference to be built interiorly to touch the former arcs, and the four triangular curved spaces closed and wedged together with masonry, the whole will stand equally firm as if the middle had been solid; and thus an aperture for light will be formed the same as in dome vaulting.

The only improvement made by the moderns in vaulting, is the cylindro-cylindric arches, which are made in opposite sides of a vault, and when regularly repeated, have a very beautiful effect.

In warehouses, which are loaded with the greatest weights, and where the walls are placed at a remote distance, it becomes necessary to introduce many supports to the floors, which if constructed of timber are liable to both fire and rot, and thereby exposed to sudden danger; every precaution should therefore be taken to prevent the risk to which they are thus exposed; at least as far as may appear eligible in the profits arising from the articles to be deposited making a full compensation for the additional expence. The end will be fully answered by the introduction of groins, which not only answer the same purpose as the flooring of timber work and the wooden posts which support it, but are more durable, and a certain proof against both fire and rot. Though groins are only employed in the lower stories of buildings, owing to the great expence which would be incurred by the great thickness of walling and the diminution of space which would be occasioned thereby, they may at all times be used in cellars and ground stories, without much additional labour or expenditure of materials.

It has been found that brick groins, rising from rectangular piers, are inadequate to the weight they have to support, and incommodious to the turning of goods round the corners of the piers. An improvement has been suggested by Mr George Tapen, architect, in a small pamphlet lately published, where he judiciously recommends the piers to be constructed octagonally, and the square angles of the groin to be cut off equal to the breadth of the side of the octagonal piers. He gives a very satisfactory reason to this purpose, that the angles of groins built in the common way, forming a right angle, are hardly capable of sustaining themselves, and much less the load which is required to be supported, owing to the bricks being so much cut away at the angles in order to fit them thereto, that they have little or no lap upon each other. This scheme should certainly be carried into practice wherever groins are applied to such uses.

In the construction of edifices for dwelling, they ought always to be employed in cellars and other damp situations, and particularly in cellars which have paved apartments above.

Groins for use only, may either be constructed of brick or stone, as the material of the one or the other may be more easily procured. If they are only to be employed by way of proportion or decoration, their beauty depends on the generating figure of the sides, the regularity of the surface, and the acuteness or sharpness of the angles, which ought therefore to be rendered obtuse. In the best buildings, where durability and elegance are required at the same time, they may be constructed of wrought stone; and where elegance is wanted at a small expence, of plaster, supported by timber-work.

Groins are constructed upon two different ways, according as they are built of stone or brick, or constructed of timber-work, lathed and plastered over. In the former case, a timber centering is made to form the concavity, and placed in order to support the groin during its erection. The centering consists of several ribs, disposed at three or four feet distance, made to the size of the vault which has the greatest opening. These ribs rest at their extremities upon beams supported by standards, and are boarded over without any regard to the transverse opening, which is afterwards formed by another set of ribs adapted thereto, and then boarded so as to meet the boarding of the first vault, which, if it be of considerable breadth, must have short ribs fixed upon its surface, in order to sustain the boarding of the transverse opening, and thus the centering will be completed. It is obvious in forming the ribs for each vault, that the outer curve must be the arc of a circle or ellipse within the curve of the vault, and at a distance from it towards the axis equal to the thickness of the boarding. In the making of the ground centre, it will be necessary to find the place of the angles upon the boarding of the large vault, in order to ascertain the place of the ribs and boarding of the transverse vault. This may be done in three different methods. If two straight edges are placed vertically at the angles, and another straight edge or extended line be made to touch the surface of the boarding, and marked at all the points of contact, keeping this straight edge or line always upon the edges of the two vertical straight edges; the defect of this method is, that the place of the angles at the bottom can never be found, as it would require the cross straight edge or line to be of infinite length, and the vertical ones infinitely high. A more eligible method, where there is room, is to fix two ribs in the transverse part, and direct a level straight edge upon the edges of these ribs, so that the end may come in contact with the boards, and mark the boarding in this place; find a number of points in the same manner as may be sufficient for the purpose, and curves being drawn through the points, will give the curves for fixing the ends of the ribs. But the best method is by the following geometrical problem.

Plate CXIX. Fig. 1. is a cylindrical groin; No. 1. the plan, No. 2. the elevation. Such groins as this frequently occur in lobbies, halls, passages, antirooms, &c.

Fig. 2. is a cylindroido-cylindric groin; No. 1. the plan, No. 2. the elevation. It is this kind of groining that generally occurs in cellaring; to construct which, a centering must be formed as at Fig. 2. No. 3, 4, 5, and 6. No. 3. shows the cylindroidal part, which is the widest opening, boarded over the whole length; then in order to fix the transverse boarding, as at No. 2. the lines AB, CD, and EF, GH, No. 3. must be drawn upon the boarding for the wide opening, either by the former mechanical means, or by the following geometrical process. No. 5. shows the end of this boarding. If the wide opening be of considerable dimensions, the shallow ribs, called jack-ribs, are fixed between the lines to the height of the cross-vault, and made less by the thickness of the boarding, so as to come within this thickness of the height of the groining. No. 4. shews the left hand part completely boarded in; No. 5. the end of No. 3. No. 6. the end of No. 4., shewing the face of one of the ribs of the centering, the thickness of the boarding, the jack-ribs over the boarding, and the posts and ends of the beams that support the whole.

Prob. I. To find the mould or curve for determining the place of the angles upon the boarding of the cylindroid, in order to fix the jack-ribs and transverse bordering of the cylindric vault, No. 4.

Prob. II. Let it be proposed to find the angles of the groin on the surface of the foregoing boarding. In order to prevent confusion of letters, we shall suppose the seal enlarged. Let AEM, Plate CXIX. Fig. 2. No. 7. be half the rib for the cylindroido part; the bases AM, and MN, being at right angles to each other, produce MA to M^e; extend the curve AE upon AM^e, from the equal parts or arcs Ab, bc, cd, dE, to Af^b, f^bh^c, h^ck^d, k^dM^e; through the points of division draw ordinates; make f^bg, h^ci, k^dl, M^eN, equal to fg, hi, kl; MN, and through the points g, i, l, N, draw a curve, which, when bent round the bordering at No. 3. from A to I, from C to I, from D to I, from B to I, &c. determines the place of the angles.

Prob. III. To find the form of the end of the boarding of the cylindric parts, in order to fit it against the boarding of the cylindroido part, stretch out the parts Mo, op, pq, qR, of the arc MR, in the straight line MN^r, from M to s^o, from s^o to t^p, from t^p to u^q, and from u^q to N^r; draw the ordinates MA, s^oq, t^pi, u^ql, which make equal to MA, $s\,g$, t i, $u\,l$; draw the curve A q i l N, and the thing required is done.

Centering to Gothic Groins.

In one species of Gothic groins, the lines of concourse of the sides of the arches at the summit, cross one another in level lines parallel to, and equidistant from, the sides of the building. The vaulting is supported upon several ribs springing from the head of each pillar, and terminating upon the transverse lines of the ceiling at different equidistant points. The surface of the vaulting lying upon, and between any two adjacent ribs from middle to middle of these ribs, may be considered to be a cunioid, and the ribs may be considered to be sections of the cunioid. The surface of the ceiling between any two adjacent ribs, will therefore have this property, that a straight line or edge applied every where level or parallel to the horizon, to two given points on the surface between any two ribs, will coincide entirely with the said surface. From what has been said, it appears that the seats of the joints of the arches between any two ribs, will meet each other in one and the same point in the seats of the summits of the arches. It will readily appear, that if several ribs spring from the top of the same pillar, each from a point in the circumference of a circle, or from an angle of a polygon, that there will be as many portions of different cunioids as there are pairs of adjacent ribs; and consequently the point of concourse of the seats of the joints of each portion will be in the seat of the summit of the arches, where a straight line drawn through two adjacent points in the said circumference meets the seat of the summit of the arches. If several adjacent ribs from the same pillar rise from as many points in a straight line, all the seats of the joints for each, and all the portions, will have the same point of concourse. What has now been said will be clearly seen by the following diagrams, Plate CXX.

Fig. 1. shows the plan of Gothic groining, where the ribs spring from points in the circumference of a circle, terminating the head of each pillar; and consequently, if the arches have several points of concourse, two of these points will run too far out of the diagram for their centres to be marked.

Prob. IV. To determine the seats of the joints, draw half the sectional curve ABC between two opposite pillars, upon its seat AB: divide the curve AC into as many equal parts as there are to be courses: through the points of division draw ordinates to cut the seat AB: divide BD into the same equality of parts respectively as BA: let *e* be the next adjoining point to D: produce *e* D till it meet the seat of the summit; but if the part of concourse run out to a great distance, which is not accessible, produce *e* D to *n*; drawn *n o* parallel to DB, meeting the seat of the summit at *o*; divide *o n* in the same proportion as BD; draw lines through the corresponding point of division in *o n* and BD, and produce them till they meet the seat of the next diagonal *e f*: join *g e*, which produce; but if it is likewise inaccessible, proceed in the same manner, by drawing a line parallel to *e f*, and dividing the line so drawn in the same proportion as *e f*; and draw lines also through the corresponding points of division, and produce them to meet the seat *g h* of the diagonal, and the seats of the joints will be completed for one side. Produce *g i* to *p*, and draw lines from the points of division *g h*, to the seat *i k* of the next rib, tending towards *p*: produce *i l* to *q*, and draw lines tending towards *q* from the points of division in *i k*, to *l m*; and the seats of the joints will be completed for one quarter of the groin.

Prob. V. To find any rib, suppose the diagonal rib represented by its seat AB or EB, Fig. 2.

Take AB, with its divisions, and place it upon CD, Fig. 3: raise ordinates upon CD, equal in height to those of the half section upon EF, and trace a curve through the extremities, and it will form the angle rib over the seat AB. Any other rib will be found in the same manner.

Instead of the rib Fig. 3. being found from its seat, suppose the rib Fig. 4. to be described with a compass: let the curve EM, Fig. 2. be divided into equal parts, and lines be drawn to meet EL parallel to the base EF, and let lines be also drawn perpendicular to, and meeting EF: let the base GH, Fig. 4. be equal to the seat AB; and HI equal to MN: make the distances on GK, Fig. 4. equal to those on EL, Fig. 2.: from the points of division, draw lines parallel to GH, to meet the curve GI: draw lines perpendicular to GH, to meet it: apply the divisions to AB and BE, Fig. 2; and they will be the points for drawing the seats of the joints.

Another method for finding points in the seats of the angles and joints is, by dividing all the seats of the ribs in the same proportion as in Fig. 5, which is the same rib with Fig. 2: the parts are taken from PQ, PR, Fig. 5, and applied to ST, SU, Fig. 2, which will give the directing points of the seats of the joints, and also of the remaining ones. Fig. 6. is the rib corresponding to ST, the base being divided, as PQ or ST.

Fig. 7. is an equilateral fan groin. In this the four trilineal spaces, formed by the four quadrants, and the circle inscribed, are all in the same horizontal plane; the surface within the entire circle is generally horizontal, but may be raised with an arched concavity of any form whatever; the curve of the rib, continued through this circle to meet in the centre, would have no bad effect, and would form a kind of pointed dome.

Fig. 8. is an oblong fan groin. In this diagram, the sides of the transverse arch meet at an interior angle, and the line of concourse terminates by the seat of the horizontal rib, the radii of which is half the breadth of the building; the four tricurvilineal spaces, comprehended by the arcs of the opposite horizontal ribs, and the inscribed circle, are horizontal planes, and the inscribed circle may be as in the preceding observation. These are generally filled with fan work. It may be here observed, that the summit lines, AB, CD, EF, GH, will not be straight lines, but curves, which will run higher as they approach nearer to the centre.

Cylindro-cylindric Arching.

Plate CXXI. Fig 1. is a plan of groining and arching in three aisles. The side aisles, AAA, BBB, are vaulted with cylindric groins: the middle vault and principal aisle, CCC, being higher than the sides, form cylindro-cylindric arches. The principles of construction are shown in the following problem, so far as regards the construction of the angular ribs, for lath and plaster, of the cylindro-cylindric arches. Fig. 2. is a section of the said arch.

Prob. VI. To describe the angular rib of a cylindro-cylindric arch, and to range the under edge, so as to range with the two sides of the said arch, Fig. 3. Let AB be the side of the groin, corresponding to *d e*, (Fig. 1.) and BC the side corresponding to *e f*, the diameter of the vault of the middle aisle, the dimensions being here extended to five times that of the plan, in order to prevent the confusion of lines, which would take place in consequence of a smaller scale: let the sides AB, BC, be placed in position, the angle of which is here a right-angle: divide the half arc, standing upon AB, into any number of points, by the points of division, 1, 2, 3, 4; produce the side AB to *h*, and the side CB to *d*: parallel to AB draw 1 *a*, 2 *b*, 3*c*, 4 *d*, cutting B *d*, at *a*, *b*, *e*: from B, with the radii B *a*, B *b*, B *c*, B *d*, describe arcs *d*, *h*, *c*, *g*, *b f*, *a e*, cutting B *h* at *e*, *f*, *g*: parallel to B *c* draw *e i*, *f k*, *g l*, *h m*, cutting the arc upon the diameter BC, at the points *i*, *k*, *l*, *m*: parallel to AB draw *i n*, *k o*, *l p*, *m* G, and parallel to BC, draw 1 *n*, 2 *o*, 3 *p*, 4 G, and through the points *n*, *o*, *p*, G, draw a curve, which will give half the seat of the angle rib: join BG, and through the points

n, o, p, G, draw $D\,v$, $E\,w$, $F\,x$, $G\,y$, which make respectively equal to $r\,1$, $s\,2$, $t\,3$, $u\,4$; and draw the curve $B\,v\,w\,x\,y$, which will give the under side of the angle rib.

Draw HI parallel to BG, at a distance from BG equal to the thickness of the stuff, which must be equal to the thickness of the angle rib, together with the waste or greatest recess of the hollow: where the lines $1\,n$, $2\,o$, $3\,p$, 4 G, cut the line BG, draw ordinates parallel to $D\,v$, $E\,w$, $F\,x$, $G\,y$; also through the points, where the lines $i\,n$, $k\,o$, $l\,p$, $m\,G$, cut HI, draw another set of ordinates parallel to $D\,v$, $E\,w$, $F\,x$, $G\,y$, making both set of ordinates of the same height with the ordinates $D\,v$, $E\,w$, $F\,x$, $G\,y$, and trace a curve through the extremities of each set: the first curve shews the concourse of the two sides, or angular line; the next, the ranging upon the side of the rib which faces the arc AB; and the outside one, the ranging upon the side of the rib which faces the arc B, or ranges with the large opening. The under edge of the angle rib is first cut out at right angles to the sides, and the lines are drawn upon each respective side, according to what is here shown. In order to find the place of the angle corresponding to its seat on the plan, take the stretch of the parts $B\,v$, $v\,w$, $w\,x$, $x\,y$, and extend them in a straight line from B to D^v, from D^v to E^w, from E^w to F^x, from F^x to G^y; draw the ordinates $D^v n$, $F^w o$, $F^x p$, which make equal to $D\,n$, $E\,o$, $F\,p$, and draw the curve B, n, o, p, G, which, being bent under the angle rib, will give the line of concourse.

In practice, it would be better to get out the angle rib in two or three parts, otherwise the waste of stuff would be enormously great: this is shown at the other half. The process is the same as what has been described in the first half.

On Roofing.

A roof is that part of a building raised upon the walls, and extending over all the parts of the interior, in order to protect its contents from depredation, and intense changes of weather.

Roofing, in carpentry, is the timber work which is necessary to support the external covering.

The most simple form of roofs is that consisting of a level plane; but this description of roofs is only adapted to short bearings, and is not calculated to resist torrents of rain or moisture from penetrating the interior. The next simple form is, that which consists of an inclined plane; and though well calculated to resist the injuries of the weather, and to admit of greater strength than a level disposition of the timbers, it is far from admitting of the most strength from a given quantity of timber, and occasions a want of correspondence in the symmetry of the fabric, or otherwise an unnecessary height of walling. The best figure is that which consists of two sides equally inclined to the horizon, terminating at the summit over the middle of the edifice in a horizontal line or ridge; so that the section made by a plane perpendicular to the ridge, is every where an isosceles triangle, the vertical angle being the summit of the roof. This form is very advantageous in saving timber, as it may be executed with the same scantlings, to span double the distance that the single sloping roof may; or in buildings of the same dimensions, the scantlings of the timbers will be greatly reduced.

The ancient Egyptians, Babylonians, and other eastern nations of remote antiquity, constructed their roofs flat, a practice which is still adopted by the present inhabitants of those climates. The ancient Greeks, though possessing a mild climate, but sometimes liable to rain, would soon find the inconvenience of a platform covering; and accordingly raised the roof in the middle, declining thence towards each side of the building, with a gentle inclination to the horizon, forming an angle from 13 to 15 degrees, or the height from one eighth to one ninth part of the span. In Italy, where the climate is still more liable to rain, the ancient Romans constructed their roofs from one-fifth to two-ninth parts of the span. In Germany, where the severities of the climate are much more intense than in Italy, the ancient inhabitants, as we are informed by Vitruvius, made their roofs of a very high pitch. When the pointed style of architecture was introduced into Europe, high pitched roofs were consonant to its principles; and therefore formed externally one of the most striking features of the Gothic style, the prevailing proportion being the equality of the rafters, and the breadth or span of the roof, or the rafters the sides of an equilateral triangle, of which the spanning line was the base. During the middle ages, this form prevailed not only in public, but also in private edifices, from the most sumptuous mansion to the cottage of the labourer; and this equilateral triangular roof continued in vogue till the expulsion of the pointed style, by the introduction of Roman architecture, introduced by the celebrated Inigo Jones. When the rafters were made three-quarters of the breadth of the building, the proportion was called true pitch, which still prevails in some parts of the country where plain tiles are used; and subsequently, the square seems to have been considered as true pitch. But in large mansions, erected in the Italian style, roofs of a pediment pitch, covered with lead, were introduced. In the present day, where good slates are to be obtained in abundance, the roofs may be covered from the pyramidal equilateral Gothic, down to the gentle inclined Greek pediment. In respect to the present practice, the proportion of the roof depends on the style of the architecture of the edifice, the ordinary height being from one-third to one-fourth part of the span.

There are some advantages in high pitched roofs; they discharge the rain with greater rapidity; the snow does not continue to be so long on their surface; they may be covered with smaller slates, and are not so liable to be stripped by heavy winds as low roofs; but low roofs have less pressure on the walls, and are much cheaper, since they require shorter timbers, and consequently smaller scantlings.

The roof is one of the principal ties to a building, when executed with judgment; as it connects the exterior walls, it also binds the whole into one mass, and secures the work from a state of decay, which would soon ensue from the injuries of rain and frost, so as to rot the timber, destroy the connection of bond in the walls, and cause the building ultimately to fall.

Prob. VII. The figure ABCD of the wall plate of a hipped span roof, and the height of the roof being given, to find the backing of the hips, the angles made upon the sides of the purlins by their longitudinal arrises, and the angles made upon the sides of the jack rafters, the roof being equally inclined to the different sides of the building, Plate CXXII. Fig. 1.

Let the two sides, AB, AD, and DC of the wall plate, be at right angles to each other, and the end CB at oblique angles to AB and CD; draw the seat EF of the ridge, in the middle of the breadth, parallel to AB and

DC; make AG and DH equal to half the breadth of the building; join GH, which will be the seat of the common rafters adjoining the hips. Make EI equal to the height of the roof, and draw IG and IH, which are the length of the common rafters. Draw ED and EA, the seats of the hips; make EK equal to EI, and draw KA, which gives the length of each hip. Through any point L, in the seat of the hip AK, draw MN perpendicular to AE, cutting the adjacent sides of the wall plate at M and N; take the nearest distance from L to the rafter AK, and make LO equal to it, and draw OM and ON, and MON is the backing of the hip, represented by their seats AE and DE. This operation is the same as having the two legs of a right angled solid angle to find the angle opposite to one of the legs, the angle MON being exactly double of the angle so found; for the hipped angle of the roof consists of two equal solid angles.

Suppose that the bevel end at CB is inclined at a different angle to the other sides, and let FC and FB be the seats of the hips, draw FQ perpendicular to FC, and FP perpendicular to FB, and draw QC and PB, which are the lengths of the hip rafters. The backings, SUT and VWX, are found in the same manner as above, and may be described in the same words.

From A, with the distance AK, describe an arc, cutting GH at J, and join AJ, GJA will be the side bevel which the jack-rafters make with the hips; and if a right angle be added to the same angle GJA, the obtuse angle thus formed will be the angle which the upper arris of the side of the purlin, placed in the inclined side of the roof, makes with the hip rafter.

Let a be the position of a purlin in the rafter HI; in GH take any point b, and draw $b\,c$ parallel to the inward direction of the purlin a; from b, with any distance $b\,c$, describe an arc $c\,d$, cutting GH at d; draw $b\,e$, $c\,f$, and $d\,g$, parallel to EF, the former two cutting ED at e and f; draw $f\,g$ parallel to GH, and join $e\,g$; produce $b\,e$ to h, and $h\,e\,g$, or $b\,e\,g$ will be the angle required, according to which side it is applied. This will be found to be the same thing as one of the legs, and the adjacent angle of a right-angled solid angle being given to find the hypothenuse. In the same manner, if neither side of the purlin should be parallel to the inclined side of the roof, as at k in the rafter GI, the bevel or angle upon each side will be found.

Fig. 2. shows half the angle of the backing of the hips; the length of the common and hip rafters; the bevel of the jack-rafters on their upper sides in an equal inclined roof, without laying down or drawing any more than the necessary seats; and this is all that is necessary when each side of the roof is alike; AB being the wall plate between the hip and the rafter which joins the top of the hip, AC [illegible] seat of the rafter which joins the top of the hip, BC the seat of the hip, AF the length of the rafter which joins the hip, BE the length of the hips, CHG half the backing, ADB the angle which the jack-rafters form with the hips on their upper sides, and consequently, with the addition of a right-angle, the side bevel of the purlin.

Fig. 3. shows the same bevels, excepting that the side joint of the purlin is found by a different process, thus: From B, with the distance BA, describe an arc at D; from G, with the distance AC, describe another arc, cutting the former at D; join BD, and the angle CBD will be the angle in the plane of the roof, made by the lower arris of the purlin, and the joint against the hip rafter.

Fig. 4. is a diagram, shewing the lengths of the parts and angles concerned in the roof, in the same manner as above; but the plan of the building, or form of the wall plate, is a quadrilateral, which has neither pair of its opposite sides parallel. The method of executing the roof in this case, is to form a level on the top, from the top of the hips at the narrow end to the other end, as otherwise the roof must either wind, or be brought to a ridge, which will form a line inclined to the horizon: Either of the two last cases is very unsightly.

Besides the angles already mentioned, (see Fig. 2.) AFC shows the angle formed by the upper side of the rafter, and the ridge piece; and the angle BEC, the angle which the top side of the hips makes with a vertical line; also the angle FAC, shows the form of the heel of the common rafters; and EBC, that of the hips.

It may be here noticed, once for all, that the bevels, or angles, concerned in hip roofing, are no more than the sides or angles of right-angled solid angles, consisting of three plane angles. The quantities in degrees may be found as in spherical trigonometry, by considering the plane angles, which constitute the solid angles as sides, and the inclinations of the planes as angles.

Circular, Elliptical, and Polygonal Roofs.

A circular roof may be executed with timbers disposed in vertical planes, whether the ribs or rafters are convex, concave, or straight, without any tie between the rafters or ribs, even though the wall were ever so thin; provided that it be only sufficient to sustain the weight of the roof, by joining the wall plate, so as to form a chain, a ring, or endless plate, and by strutting the rafters in one or more horizontal courses, without any danger of lateral pressure, or of the timbers themselves being bent by the weight of the covering; but the same cannot be done with the roof of a rectangular building, for single parallel rafters would not only obtain a concave curvature, but would thrust the walls outwards. Hence, the means of executing circular roofs with safety are simple; but those for straight sided buildings are complex, and require much more skill in contriving, according to the utility of the space between the rafters, which may be found necessary in forming more lofty, or more elegant apartments, as in concave or coved ceilings.

A circular roof is that which may be formed by revolving any line round a straight line at rest in the same plane, the two being joined at the top. By this definition, the figure may either be a cone, or a concave or convex surface, or mixed.

Polygonal roofs are those, the horizontal sections of which are similar figures.

An elliptical or ellipsoidal roof is one, the horizontal sections of which are all similar ellipses.

A polygonal roof, with a great number of sides, approaching very nearly to a circle, is stronger than one of fewer sides; the fewer the sides, the weaker will the roof be, and more liable to get out of order. A roof executed upon an equilateral and equiangular plan, is much stronger than one elongated, whatever be the number of the sides.

All circular roofs are, for the same reason, stronger than elliptic ones; the pressure in the former case being equally distributed round the walls, the force of the rafters tending only to keep the circular wall plate in a state of extension.

The roofs of rectangular buildings have generally their sides in plane figures; but those of polygons and circles have a variety of figures, particularly when their plans are equilateral and equiangular: They have sometimes the sides of their vertical sections straight, sometimes concave, but most frequently convex; and then, as has been observed, they are called domes; sometimes they are undulated, viz. both concave and convex.

Roofs, upon circular and polygonal plans, are also denominated from their vertical axal sections, as well as from their horizontal sections. Thus, if the axal section be a parabola, hyperbola, or semiellipse, the roof is denominated a paraboloidal, hyperboloidal, or spheroidal dome. If the axal section is a figure of contrary curvature, and the concave part at the bottom, the roof is denominated a bell roof.

An annular roof is a circular roof, with an aperture through the middle, the axal section being a semicircle, or semiellipse, or a segment.

Covering of Circular Roofs.

Circular roofs may be covered upon two different principles; one is, by supposing the axal section to be divided into a number of small equal parts, and the roof cut by planes through the points of division parallel to the base, and by considering the frustums of the solid as so many frustums of a cone; and the covering of each respective part will be found as in Problem XX. page 411. The other principle is, by dividing the circumference of the base into a number of small equal parts, and supposing axal sections to be made through the points of division, thereby considering the surface of each axal portion as the surface of a cylinder. The covering will be found as in Problem XVII. page 410. The distance between the points of division in the former case, must be less than the breadth of the boards which are to form the envelopes of the covering, in order to make the convex edge of the board: this distance must therefore be less, as the length of the boards is greater. In the latter case, the distances between the points of division may be exactly equal to the breadth of the boards. It is true, that the surface of each part is spherical or convex, and therefore can neither be considered as the frustum of a cone, nor that of a cylinder; but if the distance between the divisions be small, the surfaces will be almost straight in all the axal sections, so that there will be no practical difference, even though the widest boards were used in moderate sized works. The boards which thus form the envelopes must be then in order, that they may comply with the surface of the circular roof to be covered. It is here proper to notice, that when boards are bent, so as to form a surface either concave or convex, that they are much stronger than if the surface were a plane, even though the ribs were the same distance in both; but in order to make the boards bend regularly and truly, the ribs ought to be disposed at a nearer distance at the widest place, which is at the bottom, than the rafters of the common roof. When the ribs are disposed in axal planes, they will come in contact with each other at the top, unless they terminate upon a circular kirb, of a diameter sufficient to prevent their doing so; but as the intervals at the top are always much less than at the bottom, the ribs are sometimes discontinued, in order to reduce the intervals nearer to an equality of breadth throughout the length of each. The execution in this way will save the timber work, and, consequently, lessen the expences. Sometimes the ribbing of circular roofs only consists of several principal axal ribs, and the intervals filled in with jack ribs, which, if the surface to be covered be spherical, are portions of lesser circles of the sphere, and are disposed in parallel vertical planes.

Prob. VIII. To cover a dome by bending the boards horizontal, by considering the surface as the surfaces of as many conic surfaces as there are boards. The axal section being given, Plate CXXIII. Fig. 1.

Let HAF be an axal section of the dome; draw the axis GA, and produce it to I; divide the curve of the half into the equal parts *b c*, *c d*, *d e*, *e* F, the common measure or part being less than the breadth of the rectangular board; produce *d c*, to cut the axis produced at *l*; from *l*, with the distance *l c*, describe the arc *c n*; from the same centre, with the distance *l d*, describe the arc *d o*: then *c d o n* will be the form of the board or envelope to cover the frustum *c d q r*. In the same manner, the boards to cover the other frustums will be found. Thus by producing *b c*, *d e*, *e* F, the centres *k* and *m* for covering the opposite conic frustums *b o r s*, *d e*, *p q*, will be found, the centre for *e* FH *p* being inaccessible.

Prob. IX. To cover an annular vault, upon the principle of resolving it into conic frustums. The axal section, and inner diameter of the annulus being given. Fig. 2.

Let A *b c d e* F be the axal section, FG the inner, and AK the outer diameter; bisect AK by the perpendicular IL, and IL will represent the axis: then, if the points A *b*, *b c*, *c d*, &c. be the breadths of the intended boards, by producing the chords to the axis, the form of the envelopes will be obtained, as in Problem XX. page 411.

In these two last problems, the reader will have observed the inconvenience of obtaining the centres of the boards near the base, and the absolute impossibility of obtaining that at the bottom. The methods of finding the forms of the boards where the centres are thus inaccessible, will be shown by the following problem, to which the three following lemmas are a preparation.

Lemma 1. If, in a circle, there be taken any two equal chords AB, BC, and AE and BF any two parallels; and if the angle CBF be bisected by BD, meeting the circumference in D, and AD drawn, then AD will also bisect the angle EAB. Fig. 3.

Lemma 2. If, in a circle, there be taken any series of equal chords AB, BC, CD, DE, and if the angle ABF be bisected by BK, meeting the circumference in K, and KC, KD, KE be joined, and CG, DH, EI be drawn parallel to BF; then KC, KD, KE will bisect the angles BCG, CDH, DEI. Fig. 4.

Lemma 3. If there be any two inclined lines AB and CD, and if AE be drawn parallel to CD, forming an obtuse angle BAE, and if the angle BAE be bisected, the bisecting line AC will make equal angles BAC and DCA, with each inclined line AB and CD. Fig. 5.

Prob. X. To find the form of the boards at the bottom of a dome, considering the surface as the surfaces of as many cones as are rows of boards, when the centres of the circular edges of the boards are inaccessible. Fig. 6.

Let ABC be an axal section of the dome, and suppose *f g* to be the place of the last board on this section; draw the representation of the axis DB; produce DB and *g f* to meet in E; from the centre E, with the distance E *f*, describe the arc *f l*, the concave edge of the board cutting DB at *l*; join *f l*, and produce *f l*, cutting the circumference ABC at *m*; let *g h*, *h i*, *i k* be the places of the following boards nearer to the bottom;

draw gm, hm, im, km, cutting DB at t, u, v, w; draw gp, hq, ir, ks parallel to AC the base, cutting DB again in the points p, q, r, s: then will pg be half the length, and pt the height of the first board, the centre of which is inaccessible; also hq half the length, and qu the height of the next board; ir half the length, and rv the height of the next; likewise sk half the length, and sw the height of the last.

For draw fn parallel to DB, and the angle nfl will be equal to the alternate angle flE; but because El and Ef are equal, the angle flE is equal to the angle lfE; therefore the angle lfE is equal to the angle nfl, and consequently the angle nfE is bisected by fm; but, by Lemma 2, if there be taken any number of equal chords fg, gh, hi, ik, kC, and if the anglo nfE be bisected by fm, meeting the circumference in m, and gm, hm, im, km be joined, and gx, hy, iz, k, &c. drawn parallel to fn; then gm, hm, im, km, will bisect the angles fgx, ghy, hiz, ik, &c. It may now be shown as follows, that if any angle ghy be bisected, the angle ghm or ghu will be equal to the angle Buh; therefore, if hg and uB were produced, their point of concourse would be the centre of an arc that would pass through h and u. For, since hy is parallel to BD, the alternate angle yhu is equal to the angle huB; but the angle yhu is equal to the angle ghu; therefore the angle ghu is equal to the angle huB, as was to be shown.

Plate CXXIV. Fig. 1. represents a semicircular dome, boarded with the joints in vertical planes.

Fig. 2. is a segment dome, boarded with the joints in vertical planes.

Fig. 3. is a bell roof, boarded with the joints in vertical planes.

Fig. 4. The manner of finding the form of the board or envelope, by considering the surface of the dome as consisting of as many cylindric parts as there are boards. See Problem XVII. page 410. In this, the axal section is considered as the section of the cylinder.

PROB. XI. To find the envelope or form of the board, having the axal section given, Fig. 5.

Let AB be the breadth of a board, or the breadth of the envelope; bisect AB at C by the perpendicular DE; make CE equal to the length of the arc from the bottom of the dome to the summit, which may be found by calculation; divide the arc AD into any number of equal parts, and draw the sines parallel to AB; divide CE into the same number of equal parts, and draw lines parallel to AB; make ordinates on each side of CE, reversed to the order of the sines, and the curve being drawn on both sides, will form the board.

Fig. 6. shows the manner of finding the envelope of Fig. 2, in the same manner as in Fig. 4.

Fig. 7. shows the method of finding the envelope of Fig. 2, without the use of the axal section. In this Figure, AB is the breadth of a board; AEDFB a circular zone, similar to the contour of Fig. 2; the part EDF being flat, corresponding to ef, Fig. 2; the arc AE, Fig. 7, being similar to ae, Fig. 2; and CG, Fig. 7, equal to ae, Fig. 2. The operation is the same as in Fig. 5, as will be obvious by inspection.

Fig. 8. shews the manner of finding the covering of Fig. 3, in the same manner as in Figs. 4. and 6.

Fig. 9. is an elliptical dome: No. 1. the plan; No. 2. the elevation; No. 3. the half section of the elevation; No. 4. a section of the plan.

Fig. 10. is a circular dome and elliptic elevation; No. 1. the plan; No. 2. the section.

Fig. 11. shews the manner of covering the domes in Figs. 9 and 10, the same as in Figs. 4, 6, 8, by laying down the rotative section, whether on the plan or on the elevation.

The principle of executing niches with spheric heads depends entirely upon the properties of the sphere; and therefore, since all the sections of the sphere are circles, and those which pass through the centre are equal, and those which are more remote from the centre are less than those which are nearer to it, if a hemisphere be cut at right angles to the plane of its base, its section will be a semicircle of greater or less diameter, as it is nearer or more remote from the centre.

First, let the section be made through the centre at right angles to the plane of the base, then the hemisphere will be divided into two equal portions, each a quarter of the sphere. Each of these quarters will have two planes at right angles, and each plane will be a semicircle. One of these spheric portions will represent the head of a niche, the plan and elevation of which are both semicircles. In this case the ribs, the ground plan, and the face, will have the same curvature, and consequently may be drawn with the same radius.

Secondly, let a hemisphere be cut by a plane at right angles to its base, but not through the centre, it will then be cut into two unequal portions, the common section of which will be a semicircle. The smaller portion will represent the head of a niche, the plane of which is the segment of a circle, and the elevation is a semicircle; and because the segment is a part of the base of the hemisphere, and the elevation a semicircle upon the same base, and since the semicircle is remote from the centre, it will therefore have a less radius than the segment at right angles to it. Now, since the under edges of the ribs of the niche are in the spheric surface, and since these may be made in planes tending to the centre, the ribs will all have the same curvature; for they are all portions of equal circles of the sphere, and consequently may be drawn with the same radius as the base of the niche, and hence all the sections of a sphere are circles: And in spherical niches, as the ribs must be considered as sections of the sphere, they may be disposed in all positions; and as the head of the niche is a spherical surface, the under sides of all the ribs must be spherical; and it is evident that the spherical sides of the ribs will make the same angle all round with the plane side. The heads of niches generally consist of a rib brought close to the face of the wall, and a number of back ribs generally fastened to the front rib at the top, and a horizontal circular plate at the bottom. If the face of the wall be a plane, the two sides of the front rib, which join the under or spherical side, are two parallel planes; but when the wall is cylindrical, it is necessary that the face of the front rib should be also cylindrical, and a part of the same surface, and that the under side be spherical; the opposite side to the front may be a plane, which may either be perpendicular to the floor or inclined to it: but whatever be the position of the plane, the spherical surface will always form the same angle with the plane at all points round the ribs in their line of concourse; so that a bevel constructed with one edge circular, and the other straight, which coincides at any point with the spherical surface and the plane side, will coincide with the two surfaces at any other point. It is evident that this plane side, which is the side opposite the front of the rib, may either be disposed in a vertical plane, or in a plane inclined to the floor at many angles; but it is likewise evident, that there is some one position for the plane, which will occasion a less waste of stuff in order to make this front rib, and this position will be found to be a plane parallel to an inclined plane, which would pass through the summit of the niche, and face of the wall, and through the two extremities at the bottom where the spherical surface rises from the body. The back ribs may be circles of any radius, not greater than the radius of the sphere, depending on the situation of the ribs; but of all the circles of the sphere for back ribs, the arcs of great circles are the most eligible, as the spheric portions between the planes of the sides form the same angle with each of the planes; whereas if the arcs of lesser circles are employed, there will be as many different bevels wanted as there are ribs, and this will occasion not only more workmanship, but a much greater waste of stuff. When great circles are employed for the curvature of the back ribs of a niche, they should be fixed so as to intersect each other in one common axis, and this axis ought either to be perpendicular to the horizon, or parallel to it: the former disposition of the axis, as it affords a good fixing, in general takes place.

Prob. XII. To find the ribs of a cylindro-spheric niche, or a spherical niche in a circular wall; so that the spherical surface may rise vertically from the body, or that the cylindric surface may be tangential to the spheric surface, given the plan of the niche and of the wall, Plate CXXV. Fig. 1.

Let ABGHI be the plan of the wall, BCDEFH the plan of the niche; now the thing required is to form a front rib, so as to stand vertically in the cylindric surface of the wall over the arc GH, which is the seat of the cylindro-spheric line; also to form back ribs, in order to fasten the lath and plaster.

Let all the back ribs be portions of great circles, and let these great circles intersect each other in a vertical diameter; and let the back of the front rib be a portion of a less circle of the sphere, and the face to be so excavated as to form a portion of the surface of the circular wall. In order to do this in the easiest way, get the front rib out of a parallel thickness of stuff sufficient to work the face afterwards, so that the lower ends may rest at B and H, and the summit of the face of the said rib brought to the cylindric surface of the wall; then this disposition gives the rib a reclining position from any part of the apartment in which the niches are placed. To determine the radius of the circle according to this position, and to curve the front surface; let PQR be the back line of the plane cutting the circular wall in P and R; the distance between the outer line PQR and the inner line BFH, is equal to the breadth of the back ribs, and forms the plate on which they are to stand; join PR, and from the centre O of the plan, draw OQ at right angles to PR, cutting it in T; draw GS parallel to PR, cutting the outer edge of the plate at S; join TS, cutting the inside of the plate at Y, and draw UV parallel to TS, at a distance equal to the thickness of the front rib, cutting OQ at U, and the inner edge of the plate at V; draw VN parallel to SG, cutting OQ at N; produce ST and VU to W and X; draw OWX at right angles to SW.

Take the distances WT, XU, WY, XV, and apply them in Fig. 2, upon any straight line CE, making CF, CG, CD, CE, respectively, equal to them; through C draw AB at right angles to CE, and draw HI and MN parallel to CE; from C, with the radius CD, describe the semicircle AMDNB, and the arc MDN will give the under edge of the back of the front rib: Again, from the centre C, with the distance CE, describe an arc HEI, and this will give the line on the face, before it is formed to the curve of the wall, for ranging the spherical or under side.

In order to curve the face of the front rib to the cylindric surface of the wall, divide the quadrant DN into any number of equal parts, as six; and draw ordinates to MN. In Fig. 1. through X draw ab parallel to PR, cutting CQ at a: make ab equal to CA or CB, Fig. 2, with the semi-greater axis ab, and semi-lesser axis a N, describe the quadrant of an ellipse b KLMN: transfer the divisions on GN, Fig. 2, to ab, No. 1, and draw the ordinates cde, ikl, &c. to the quarter axis of the ellipse, cutting the line of the wall at d, g, k, &c.: Extend the arc DN, Fig. 2, along the straight line Fig. 3, from N to e^1, from N to h^2. from N to l^3, &c.: draw the ordinates NG, e^1d, h^2g, l^3k, &c.; and make them respectively equal to NG, ed, hg, lk, &c. Through the points G, d, g, k, n, &c. draw a curve, and it will complete the envelope mould, which, bent round the under edge of No. 2, from D to n, and from D to m, and a line being drawn by the curved edge, will give the cylindro-spheric line, or line of concourse of the wall and niche; and, by cutting away the waste stuff from the front part, the front rib will be formed.

To form any of the back ribs represented by FN, EM, DL, CK, all tending to the centre O, suppose the rib upon CK to be formed, its thickness is here represented; but we shall suppose the centre of the rib to be the base: draw vx and wy perpendicular to CK, from the points where the thickness terminates upon the elliptic curve, till they meet the inside of the plate at x and y; continue CK until it meet ab; through the points of meeting, and through y draw yz; parallel to which, draw x, &; then will CXy be the inner edge of the rib, Z and z the outer edge, the dotted line the base, yz, x, & the two sides of the joint at the top. This same rib is shown at Fig. 4.: in the same manner, Fig. 5, 6, and 7, will be found.

Fig. 8. is a bevel, which, being applied with the straight edge of it to the inside of the rib Fig. 2. and the wood cut away towards the front out to nothing on the under edge, at the same angle all round, and brought to its place, will form to the spherical surface of the niche, and to the cylindric surface of the wall.

A pendentive is a portion of a spheric surface, terminated on two sides by two vertical planes or straight walls, and a horizontal plane at the top.

A pendentive is therefore bounded on all sides by three circular lines, two of which are in vertical planes, and one horizontal.

Hence, if an apartment is built upon a square or polygonal plan, and from the interior faces of the walls, concave surfaces, which are portions of the same sphere, and which have one common centre in the axis of the apartment, spring upwards, and towards the axis, until they terminate in a complete horizontal circle, then as many pendentives will be formed as the walls have angles or sides.

If the springing lines upon the walls are semicircles, the pendentives will be portions of a hemisphere, having the angular points in a great circle passing horizontally through the centre.

If the springing lines are segments less than semicircles, the portion of the sphere from which the pendentives are formed, will be a segment less than a hemisphere.

The ichnography or plan of a pendentive ceiling is the triangular spaces formed by a square or polygon equal to that of the plan circumscribing a circle, the radius of which is equal to the radius of a circle which terminates the pendentives.

Pendentives are often employed in ceilings, in place of cylindric or cylindroidic surfaces, as in simple vaults, or in the composition of groins. The whole of the interior of St Paul's cathedral is vaulted with coves of this kind, which support the small cupolas. The beautiful interior of St Stephen's, Wallbrook, has its dome supported upon eight pendentives over eight columns, disposed in the angles of an octagon. The ceilings of principal passages in large edifices are sometimes arched with pendentives, supporting rows of small cupolas, or flat circular ceilings. The apartment which contains the principal stairs is most elegantly ceiled in this manner, whether the plan be square or oblong. If the plan be oblong, sphero-cylindric arches may be made in the length of the plan, by which means the pendentives may rise from the sides of a square. When the height will admit, semi-cylindric vaults will have a more graceful effect than those, the sections of which are portions less than a semicircle. In this case, the pendentives will be bounded by four vertical semicircles, the planes of which are at right angles to each other. Two of these semicircles will be formed upon the planes of the walls, and the other two by the intersection of the two semi-cylindric vaults, which will form two sphero-cylindric arches.

Though pendentives are usually portions of a spheric surface, they may be portions of an ellipsoid, or of a regular polygonal dome; or of any figure, the horizontal sections of which are circles.

Let ABCDA be the plan of a pendentive ceiling, and GHIKLEFG the section and interior elevation, the section being made by a plane parallel to one of the sides. Plate CXXV. Fig. 9.

The pendentives are formed of ribs, which must be considered as sections of a hemisphere; the plan ABCDA must be considered as a portion of the hemispheric base; the springing ribs APB, BMC, CND, DOA, are all semicircles of a diameter equal to the side of the plan, and supposed, in the execution, to be raised perpendicular to the plan. The ribs which form the ceiling are all formed of arcs which are portions of great circles, their planes bisecting each other in a vertical axis; and, as the diameter of the sphere is the diagonal of the plan, half the diameter will be the radius for all the ribs. The interior circle on the plan is the seat of the kirb. The only thing remaining to shew, is the length of the ribs, which are all different.

Prob. XIII. To find the length of the ceiling ribs.

Let it be required to find the length of the rib, the seat of which is $a\,b\,c\,d\,a$: draw $\mathrm{Y}\,f\,c$ parallel to AD: from Y, with the distance $\mathrm{Y}\,b$, describe an arc $b\,e$; and with the distance $\mathrm{Y}\,c$, describe an arc $c\,f$: on the middle point Z, of the side AD of the plan, describe the arc QR, which gives the curve of all the ribs: the concentric outer circle may be at any distance, according to the breadth of the rib, so as to make it sufficiently strong: draw $f\,g\,h$ and $e\,i\,k$ parallel to AB, cutting the arc QR at g and i, and the outer edge at h and k: draw $l\,\mathrm{Q}\,r$, $m\,n\,p\,o$, likewise parallel to AB; and draw the section of the kirb $\mathrm{Q}\,r\,o\,n$, then will $\mathrm{Q}\,n\,p\,h\,k\,\mathrm{R}\,g\,\mathrm{Q}$ be the rib required. In the same manner may all the others be found. The ribs being found for one-eighth part of the ceiling, is sufficient to mould the whole, as shown at No. 1, 2, 3, 4.

No. 1. is the rib that stands in the diagonal.

No. 2. the next succeeding one.

No. 3. the rib succeeding No. 2.

No. 4. the middle rib of the side succeeding No. 2

OA is half the springing rib: the feet of the ceiling are found by drawing lines from the ends of the seats of the ceiling-ribs on the side AD, perpendicular thereto, until they cut the top of the springing rib.

The springing ribs are here all of an equal radius, and are portions of lesser circles of the sphere.

To Scarf a beam, is to join two separate pieces of timber, so that every superficies of the one piece shall be respectively in the same plane with every superficies of the other; or, in common language, that both pieces shall be in the same straight line, and flush on all sides with each other.

Hence it is evident, that if the joints consist of a plane or planes at right angles to two opposite sides of the beam, but not at right angles to the plane of the other two opposite sides, the side of the one piece of timber with which the oblique angles are made, will form the same inclination or inclinations respectively with the plane or planes of the joint, as the opposite parallel side of the other piece will make with the corresponding or coincident plane or planes of the said joint.

There are several methods of scarfing beams, either by the joint consisting of one plane or several planes, sometimes indented into each other.

Plate CXXVI. Fig. 1. shews the method of scarfing a beam by indenting the joint at the ends, the planes of the joint being both parallel and perpendicular to the planes of two opposite sides.

Fig. 2. is the method of scarfing a beam with the coincident parts oblique to the two sides.

Fig. 3. shews the method of scarfing a beam when the joints are both parallel and perpendicular to the two opposite sides, by being tabled and indented at the ends, and keyed between the tables.

Fig. 4. represents the method of scarfing a beam with oblique and tabled joints, and keyed between the tables.

Fig. 5. exhibits the method of scarfing a beam with parallel and perpendicular joints, oblique at the ends, by forming the end of each piece into a series of steps.

Fig. 6. shows the method of making a beam of two pieces of timber, when the length of the two parts are no more than the length required; for the whole, by inserting an intermediate piece on one side of it each way, with a double series of steps.

Fig. 7. shows the method of building a beam in two thicknesses, having the parts of each half scarfed, as in Fig. 3. In this diagram, as well as in the four first, the joints are strapped across at the scarfings, and bolted on each side of the joint. The strapping is of great use in preventing the bolts from sinking into the wood.

Fig. 8. exhibits the method of building a beam in three thicknesses, as the ribs of a dome such as the Halle du Bled, at Paris.

Naked Flooring is the arrangement of the timbers to support the boarding.

Floors are constructed by different methods, according to the bearing of the timbers. When the rooms have small dimensions, the floor generally consists of single joists. When the rooms are large, the floor consists of two rows of joists, the one supporting the other above, and framed at one end into a large beam, called a Girder, which is generally disposed in the middle of the transverse dimension of the space, if there are only two lengths of joisting, with another compartment of joisting upon the other side of it. If there are three compartments of joisting, there will be two girders. The lower supporting row of joists are called Binding Joists; and the upper which is supported is called Bridging Joists. The bridging joists are most frequently notched upon the binding joists, but not to the thickness of the binding joists; so that each edge of the upper side of the binding joists are also notched, leaving the breadth of the rising part equal to the breadth of the notches in the under sides of the bridging joists.

Fig. 9. represents naked flooring without binding joists, but with a girder, into which the joists that support the flooring are framed, and the ceiling joists into deep joists which also support the boarding. No. 1. is a section shewing the end of the girder, and the ends of the ceiling joists. No. 2. is a transverse section shewing the ends of the boarding joists, the ends of the strong joists, and the sides of the ceiling joists.

Fig. 10. represents sections of a double floor. No. 1. shows the ends of the girder, bridging joists and ceiling joists, and the side of the binding joists. No. 2. shows the end of the binding joists, and the sides of the bridging and ceiling joists.

Truss Girders.

When girders are extended beyond a certain length, they become bent by their own weight, sagging downwards in the middle; and the degree of curvature will increase in a much greater degree than their lengths. An excellent method to prevent the sagging, without being supported by uprights, or posts from the ground or floor below, is to make the beam in two halves, and insert a truss so, that when the two halves are bolted together, the truss may be between them. In this truss, the two halves of the beam itself is the tie of the truss. To prevent any bad effects from the shrinking of the timber, the truss posts are generally constructed of iron, screwed and nutted at the ends; and, to give a firmer abutment at the ends, the braces are let in with grooves into the side of each half of the beam. The abutment at the ends is also made of iron, and is either screwed and nutted at each of the ends, and bolted through the thickness of both halves, having a broad part in the middle, in order that the braces may abut the whole dimensions of their section; or otherwise the two abutments are made in the form of an inverted wedge at the bottom, and rises cylindrically to the top, where they are screwed and nutted. These modes may be either constructed with one king-bolt in the middle, or with two truss-bolts placed each at one-third of the length from each end. When there are two bolts, they include a straining piece in the middle. The two braces may either be constructed of oak, cast or wrought iron: the latter material is, however, very seldom employed. As wood contracts less in length than most metals, oak is better for the purpose than cast iron; but then the parts of the core must be so much stronger. As to the bolts, wrought iron is indispensable. It is obvious that the higher the girder the parts will receive the less stress, and consequently there will be less risk of giving way by heavy weights, or long bearings.

Plate CXXVII. Fig. 1. is the section of a girder, with two braces and king-bolt.

Fig. 2. is the section of a girder, with a straining piece, two braces, and two truss-bolts, of the most approved form, and certainly the best. No. 1. represents the girder laid open, in order to show the core; No. 2. shows the two halves bolted together; No. 3. shows the edge of a washer; No. 4. the face of the same; No. 5. represents the side of the butmental bolts in the transverse direction of the girder; No. 6. the side of the same in the longitudinal direction; No. 7. represents the transverse direction of the truss-bolts or king-bolt; and No. 8. the longitudinal direction of the same.

Fig. 3. The section of a girder, calculated from its rise to sustain very heavy weights. If the tie beam is very strong, the abutments may be wedged: but then it must be observed, that the wedge ought to be very long, that the taper may be very small, so as to have no inclination to rise, and then the excess of length may be cut off afterwards; however, the bolts represented at No. 5. and No. 6. Fig. 2. are to be preferred.

Fig. 4. represents the end of a girder, with part of the bending joists on each side of it. No. 1. shews the part of the bending joist fitted in, and the manner of cutting the mortice and tenon. The tenon thus formed, with the sloping shoulder with the small projection below the tenon, is said to be tusked; and the mortice cut to receive the tusking, is said to be housed.

Fig. 5. represents the method of cocking beams upon wall-plates, according to the best method, which precludes every possibility of the beam being drawn from, or pushed farther over the wall-plate, without tearing the rising part away from the wall-plate, or splitting the piece away between the notch and the end, on the under side of the beam. The practice in former times was by a dovetail, the planes of the joint being perpendicular and parallel to the horizontal sides of the beam, two of the said planes being inclined to the vertical sides, at an equal angle to each adjacent side, and forming the dovetail at the bottom, or on the horizontal sections at the end of the beam, so as to be wider at the extremity than at the shoulder. If the timber were without shrinking, and the joint closely fitted together, this would be an excellent method; but as we are certain that the timber does shrink, a small degree of shrinking will allow a very great draught. No. 1. represents part of the longitudinal direction of the beam, and section of the wall-plate; No. 2. represents part of the longitudinal direction of the beam turned up-side-down, to shew the notching.

Wall-plates are pieces of timber laid on the walls, in order to distribute the pressure of the roof equally upon, and to bind the walls together. The wall-plates are sometimes called raising plates.

Trusses are strong frames of carpentry resolved into two, or a series of triangles, so as to make the truss act as a solid body, and thereby support certain weights, each at a given immoveable point, the truss itself being suspended from two such immoveable points. The trusses of roofs are constructed generally of a triangular form, and disposed equidistantly on the wall-plates, in parallel vertical planes at right angles to the walls. The top of the opposite walls are the two points of suspension, and the weights supported by the truss at the immoveable points are horizontal pieces of timber running transversely to the planes of the trusses; the horizontal pieces of timber support other equidistant pieces parallel to the upper sides of the trusses; and these last timbers support the covering, or the covering and timber work, to which the covering is fixed. In a truss, some pieces of timber are in a state of tension, and some are in a state of compression; but a piece of timber, which is neither extended nor compressed, is useless. If a quadrilateral figure, or frame, be so constructed, that each two adjoining timbers be made moveable round a point at their intersection, it may be put into an infinite number of forms, because the whole frame will be revolvable about the angles; but if any one of the angles be immoveable, the whole quadrilateral frame will be immoveable. Two pieces of timber forming an angle, and revolvable round a point at their intersection, may be made immoveable by fastening each end of a bar to each leg, or by taking any two points in the bar, and fastening each point to each leg. Now, if a force be applied at any of the three angular points, the triangular frame will be immoveable; but one of the two legs which form the angle will be in a state of tension, and the other in a state of compression, provided that the direction of the force applied does not fall within the angle produced; but if the line of direction of the force applied fall within the angle of the triangle, then both legs are either in a state of tension, or in a state of compression, according as the force applied is pulling or pressing. If one of the sides of the triangle be lengthened without the boundary, and a force be applied transversely to the part so lengthened in the plane of the triangle, this force will bend the side of the triangle, which is in the straight line with the side to which the force is applied; therefore, suppose again a quadrangle or quadrilateral revolvable about the angles, and a bar be fixed to any two sides forming an angle, viz. a point in the bar to a point in one of the legs, and another point in the bar to a point in the other leg; and suppose the two points not to be in two of the angles, or one of the points to be in the side, at some distance from either end, the quadrilateral will be divided into two parts, one will always be a triangle; then, if the figure be supported at two of its angles, and a force be applied in the plane of the figure to the angle opposite, the angle which has the bar fixed to its legs, so that the direction of the force thus applied does not tend to the fixed point, which is the farther extremity of the one leg where the force is applied to the angular point at the other extremity; all the sides of this figure will be bent, and the bar thus fixed will occasion transverse strains to the sides: But if the bar be fixed to two opposite angles, and if the frame be held immoveable at one of the angular points where the bar is fixed, and also at one of the other angles at the extremity of one of the legs of the said angle, and a force in any direction in the plane of the figure be applied to the angle where the frame is unsupported, and where the bar is not fixed, the frame will be by this means rendered immoveable, and the force by this disposition will not occasion any transverse strain on the sides of the frame. Suppose the frame to be pentagonal, and a bar fixed in like manner to two angles, at the ends of two adjoining sides, these two adjoining sides and the bar will form a triangular compartment in the figure. If the frame be suspended by two of the angles of the triangle, the three remaining sides will be moveable, at the extremities of the bar, round the remaining angles; but if another bar be fixed to any one of the three angles of the triangle at one end, and to one of the angles of the other three sides, to form another triangle, three of the sides of the pentagonal frame will be made immoveable, and the two remaining sides will be so likewise. In like manner, of whatever number of sides the frame consists, by first forming a triangle of two of the sides, and fixing a second bar from any angle of the triangle to one of the other angles of the figure, at the remote ends of two adjoining sides of the frame, there will be formed another immoveable side, and another immoveable point at the next angle of the frame will be given; if from this fixed point, or any of the other three points, which are the angles of the triangle, the end of a third bar be fixed, and the other end of the bar to one of the remaining angles of the frame, so as to form a triangle with the second bar, and one of the adjoining moveable sides of the frame, or a triangle, with one of the fixed sides of the frame and the adjoining moveable side, and by proceeding in this manner successively, until all the sides are fixed, the frame will be made immoveable; so that if any two angles of this frame be supported, and a force or forces be applied at one or each of the angles in the plane of the figure, the whole figure will be immoveable. Frames of a triangular form, which have to resist only a simple force, or support one weight, are most simple and best constructed of three sides, the frame being suspended from two angles, and the force or weight to the other. A triangular frame, supporting only one weight, has no occasion for any subdivisions to compart the external space, provided the compressed timber or timbers were inflexible, so as to support their own weight without bending, and the tensile timbers incapable of extension. Though a frame should have to support several weights, the external figure may be of any form whatever, provided that the points from which the weights are hung, and the two points from which the frame is suspended, be all immoveably supported, by comparting the figure with timber divisions, and thereby forming a succession of adjoining triangles, of which each two contiguous ones have a common side; that is, when two of the angles of each of the adjacent triangles are coincident. It may be proper to observe here, that though it may not be at all times eligible to divide a frame, so that all the compartments will be triangles, yet the succession must not by any means be discontinued, by the intervention of quadrilateral or polygonal figures; but these compartments may adjoin without injury to the truss. The triangle is the most simple of all rectilineal figures; it is also easier constructed, and better adapted to the discharge of rain or moisture in a roof, than any other figure; but in adopting it for large buildings, as several weights must be supported, and as there is only one point from which this weight can be suspended, it becomes necessary to take other equidistant points in the sides, in order to support the covering equally. These points may be made stationary by the former means, of dividing the interior space into a succession of triangular compartments. But if the two upper sides of the frame be of equal lengths, and equally inclined to the horizon, the opposite points may be made to counteract each other, without a concatenation of triangles, by introducing timbers from point to point parallel to the horizon: in this the compartments will be trapezoids, except the upper one, which will be a triangle. These beams may be supported by vertical bolts passing transversely through them from the points where the weights are supported, and the bolts may be nutted below the beams. This mode of securing the points of support depends entirely upon the doctrine of equilibrium; and thus a very little difference from the equality of forces might easily occasion a change of figure, to which the other method, by a series of triangles, is not liable. The securing of the points of support by beams is not confined to triangular frames, but may be applied to roofs having two or several rafters upon each side, so that their lengths and inclinations are equal, and their junctions on the same bevel. The beauty of every truss is, to dispose the timbers in positions as direct to each other as possible. Oblique directions require timbers of large scantlings, and exert prodigious thrusts on the abutments, so as to compress the joggle pieces, and render the truss in danger of sagging. Trusses are variously constructed, according to the width of the building, the contour of the roof, and the circumstances of walling below.

Tie, is any piece of timber in a state of tension, viz. a piece of timber which is acted upon by two forces which have a tendency to a more remote distance.

Straining-piece, is any piece of timber compressed by two opposite forces, which have a tendency to a nearer approach; hence ties and straining-pieces are affected in contrary directions. A straining-piece requires an inflexible piece of timber; but a chain, or rope, or small bar of iron, will answer the purpose of a tie, provided that it is incapable of any farther extension than being drawn into a straight line.

Tie beam, the timber of the foot of the truss on the lowest timber connecting the two sides for preventing the lateral pressure of the roof from pushing out the walls, and causing it to press vertically. When the tie beam is placed at the bottom, it is called a footing beam. The tie beam, besides its use in the truss, is necessary in supporting the ceiling floor. The tie beam is generally placed at the bottom of the truss; but in some buildings, in order to get a more lofty story, it is placed in a higher situation; but this disposition of the tie beam is dangerous, if very remote from the wall heads, as the weight of the roof will bend the inclined upper sides of the truss so as to make them concave outwardly. The want of the tie beam, or its not being placed at the bottom, is a great fault in the construction of Gothic edifices, as the roofs in most of these edifices have almost ruined the walls.

Principal rafters, are the two inclined pieces of timber in opposite sides of the roof fastened each to each end of the tie beam, which prevents their thrusting out the walls by the weight of the roof. The principal rafters are generally of equal lengths, and form a triangle with the tie beam when the roof consists only of two sides without a flat, and when the tie beam is laid on the wall plate.

King post, is a piece of timber in the middle of a truss, suspended at the upper end by the principal rafters from the apex of the roof, so that the king post divides the internal space into two equal compartments, each a right angled triangle. The use of the king post is to furnish a general support for the principals, and suspend the tie beam between the ends, so as to keep it from sagging.

Queen posts, are two truss posts, equi-distant from the middle of the truss, the one suspended from the head of the one principal rafter and the end of a beam on one side of the middle, and the other queen post from the head of the other principal and the other end of the beam on the other side of the middle; so that the queen posts divide the internal space of the frame into three compartments, of which the two extreme ones are right angled triangles, and the middle one a rectangle. The use of queen posts is the same as king posts, viz. for furnishing a general support for the principals at different points between the ends, by connecting timbers, and supporting the tie beam between its extremities.

Struts, are oblique pieces of timber, or braces, branching upwards from one, two, or several points in king posts and queen posts, to as many points in the principal rafters, or to as many points in the external frame. Struts are generally disposed in pairs, equally inclined to a vertical line passing through the middle of the plane of the truss, and the directions of each pair tend to the same point in this vertical line. Struts are necessary in large trusses consisting of long timbers, which have to support the covering at various points in the external frame.

Collar beam, is the piece of timber framed between the heads of two queen posts. A collar beam roof is necessary, where there is to be a platform, or wherever rooms are required to be formed in the roof, and to be of greater extension than the distance between the trusses.

Straining sill, is a horizontal piece of timber, disposed between the feet of queen posts, to counteract the efforts of the struts in pushing the queen posts nearer to each other.

Having thus mentioned the several parts of a truss, it may be proper to observe, that all king posts, queen posts, and tie beams, are ties, and therefore a string incapable of farther extension than sufficient to bring it to a straight line, or a chain, or a slender bar of iron, will answer the same purpose, as well as a piece of timber or other such inflexible material. Also, that all collar beams, principal rafters, and struts, are straining pieces, which are therefore necessarily constructed of an inflexible material, such as wood, or a stiff piece of iron. It may be farther observed, that in complex frames, such as centerings to large arches, or bridges in the act of building, the same timbers, in different stages of the work, sometimes perform the office of ties, and sometimes that of straining pieces, and in the transition of office must be sometimes in a neutral state. The material employed in such situation, must necessarily be inflexible: this is not only to be recommended here, but in every doubtful case, or where it is uncertain whether the part of the truss requires to be a tie or a straining piece; since all, or most inflexible materials, may not only be employed as ties, but as a straining piece also.

Pole plate, is a beam over each opposite wall, supported upon the ends of the tie beams, or upon the feet of the principal rafters.

Purlins, are horizontal pieces of timber, supported by the principal rafters.

Ridge piece, is a beam at the apex of a roof, supported by the king post, or by the heads of the principals.

Common rafters, are inclined pieces of timber parallel to the principal rafters, supported by the pole plates, the purlins, and the ridge piece for supporting the covering, the material of which is sometimes large slates extended from rafter to rafter, and sometimes smaller slates nailed upon boarding, battening, or hung to lath, and these nailed upon the common rafters.

Joggles, are the joints at the meeting of struts, king posts, queen posts, and principal rafters, and indeed all the joints of a roof may be termed joggles. The best form of the joggles is, that which is at right angles to the lengths of the struts or rafters, or at right angles to the tenoned piece; but this position cannot at all times be obtained, for the want of sufficient substance of timber; in this case, the joint is either made oblique, or the upper part in a line with the side of the piece which has the mortice, and the lower part perpendicular to the sides of the tenoned piece; or the joint is sometimes made partly parallel, and partly perpendicular to the morticed piece. When the joint is oblique, the force of the tenoned piece in a direction of its length, causes the end to slide upon the abutment towards the side which contains the obtuse angle, but this is in some degree counteracted by the resistance of the tenon on the lower end of the mortice. However, with regard to the stress of the timbers in a frame, the abutting joint is of little importance. M. Perronet, the celebrated French engineer, formed the abutments, and consequently the joggles, in the arches of circles, making the centre at the other extremity.

Camber beams, are those timbers which are supported upon purlins over the collar beams, and support the boarding for a leaden platform; for this purpose they have an equal declivity from the middle, in order to cause the water to descend equally on each side of the roof.

Cocking, or *Cogging*, the form of the joints which the tie beams and wall plates make with each other. And here, as in every other case of jointing, the parts must be reciprocally reversed to each other, so that the protuberant part or parts of the one, are the raised or indented parts of the other; and the parts which the bottom or bottoms of the recess or recesses are parallel to, are those which form the sides perpendicular to the surfaces from which the joints are made. The best method is by cutting a groove across the fibres in the beam to be let down, to correspond to a rising in the plate, formed by recessing the plate on each side of the rising. Another method is, by an external and internal dovetail; but this last method is almost antiquated.

Plate CXXVIII. Fig. 1. shews the form of a truss similar to that on the Pantheon in Oxford-street, London, when it was converted into an opera-house. The design was made by Mr James Wyatt. It was consumed, as well as the theatre, about the year 1792. The extent of the building within the walls was about 80 feet.

Fig. 2. shews the truss of the roof of the church of St Paul's, Covent-garden, designed by Mr Hardwick, and executed by Mr Wapshot, in 1796.

	Scantlings.		
	In.	by	In.
AA, the tie beam cambering 6 inches in the clear of the walls, the whole length being 72 feet, and the clear of the walls 50 feet 2 inches, ...	16	×	12
BC, BC, queen posts which are in the shafts, ...	8½	×	8½
DE, straining, or collar beam, ...	10	×	8
FG, king post, 14 inches broad at the joggle at the shaft, ...	8	×	8½
HI, HI, struts, ...	8	×	7½
KL, KL, straining braces, or auxiliary rafters, at top 8 inches square, and at bottom	10	×	8½
m, *m*, *m*, *m*, puncheons, or blocks, to support the principals, ...	8	×	8
NO, NO, principal rafters supported by the puncheons, by the queen posts, and by the tie beam at the lower end, and king posts at the upper end, being 8½ inches square at top and bottom	10	×	8½
p, *p*, *p*, &c. purlins, supporting the same rafters, ...	9	×	6½
GR, GR, small rafters for supporting the boarding and covering, ...	6	×	3½
SS, wall plates, ...	12	×	10

The distance of the trusses is about 10 feet 6 inches: each truss contains about 198 solid feet of timber.

Fig. 3. represents the truss of the roof of the Royal Hospital at Greenwich. The design was by Mr James Stewart, author of the *Antiquities of Athens*. It was executed by Mr Samuel Wyatt, about the year 1785.

	Scantlings		
	In.	by	In.
AB, tie beam, being in length 57 feet, and 51 feet in the clear of the walls, . . .	14	×	12
CD, iron king post, ...	2	×	2
EF, EF, queen posts, ...	9	×	12
GH, GH, &c. struts, ...	9	×	7
IK, straining beam, ...	10	×	7
HL, straining piece, ...	6	×	7
MN, MN, principal rafters, ...	10	×	7
OP, camber beam, ...	9	×	7
p, *p*, Purlins, ...	4	×	6

The timbers of this roof are well disposed, but the iron king post is of little more use than supporting the middle of the tie beam.

The remaining figures in Plate CXXVIII. shew the various joinings, in roofing, of king posts and principal rafters; of tie braces and principal rafters; of principal rafters and tie beams; of struts and truss posts; of dragon pieces, angle ties, and wall plates, with the various methods of bolting and strapping these various parts together.

Fig. 4. No. 1. represents the method of joining and strapping the principals and king posts. In this figure the principals meet each other without the intervention of the king post, which is omitted, in consequence of the shrinking of the wood between the joggles. Fig. 4. No. 2. exhibits the method of fixing the king post and tie beam, showing the manner of strapping the same. Fig. 4. No. 3. Shows a section of part of the king post through the mortice for the keys, with the manner of wedging the same. Both the mortice and the resisting piece of iron on the upper side of it, are cut with a greater vertical dimension, than what the width of the two wedges are, so that the head of the mortice through the wood goes higher than the head of the mortice through the iron; so also does the bottom of the mortice in the wood go higher than the bottom of the mortice in the iron.

Fig. 5. shews the manner of securing the king post, principal rafters, and tie beam. No. 1. shews the form of the joggle joints, and the manner of strapping the king post and principals, the king post intervening; but it is to be hoped, that this intervention will be relinquished in practical works. No. 2. The manner of bolting the lower end of the king post and tie beam, the nuts being double, and their directions, in two planes, intersecting each other at right angles; and also at right angles to the intersection, which is also the axis of the bolt; and the one direction perpendicular, and the other parallel, to the plane of the truss.

Fig. 6. shews the method of hanging the beam, and supporting it at the foot of the struts. No. 1. The two rafters, suspending a double or branched rod for supporting the lower ends of the struts.

Fig. 7. represents the method of securing the lower end of the principal to the one end of the tie beam. No. 1. The two parts secured together by means of an eye bolt. No. 2. The manner of cutting the tenon. In this, the principal is thinner than the tie beam, so that the end of the tenon forms the outer abutment, and the part on the inside of the rafter at the bottom, the inner or second abutment; both these abutments being at right angles to the rafter.

Fig. 8. represents another method of securing the rafters and tie beam. No. 1. The two joined together. No. 2. The end of the beam showing the socket.

Fig. 9. shews the method of joining the struts and king post when there is a deficiency of wood at the joggles. This also shows the method of forming the dovetail on the tenon which goes into the beam.

Fig. 10. shews the method of joining the wall plate at the angles. No. 1. The horizontal projection, showing the diagonal tie and dragon piece which contains the socket for the feet of the principal rafters. No. 2. The elevation of the high rafter framed into the dragon piece. No. 3. Shows one side of the wall plate with the sockets.

As all timber will shrink unless it has been seasoned for a considerable time, and, as the time which it requires to season must depend greatly on the thickness of the timber; so the timber in all large roofs, constructed with king posts and queen posts, will also shrink; and as the timber is large, the time required must be very long, and perhaps even then not to be depended upon. It has been found, that roofs have sustained very considerable injury by the shrinking of the timbers, in causing them to sag and press down the other parts of the building connected with them, which ought to have been supported by the roof, and by this means not only destroying the interior ceilings, by producing large fissures in the plaster of the partitions, particularly at their junctions with the exterior walls, but also destroying the appearance of the exterior. Now it has been found, that timber contracts very little in the length, even less than many of the metals, and that the evil chiefly arises from the shrinking of king posts and queen posts between the joggles. To remedy the defect, it is here proposed to have neither king posts nor queen posts, and, instead of them, to substitute long rods of iron, which will perform the office of tie braces, by suspending the tie beam, either in the middle or in two equidistant places, by one or two iron bars depending from the apex of the roof, and by pitching the lower ends of the struts upon the one or each of the places on the tie beam, supported by the iron bar or bars; the upper ends of the said struts supporting the principal rafters between their extreme points, at the required points where they are loaded by the weight of the covering, and again by suspending other rods of iron from these points to the tie beams; and thus a series of equidistant fixed points of any required number, supporting both rafters and tie beam, will be found, as may be judged necessary, and without the smallest danger of skrinking, and at less expence than truss posted or joggle posted roofs, strapped or bolted to tie beams. The iron of the straps and bolts in common truss roofs, are of considerable expence; the trouble of boring, fitting in bolts, or wedging straps, is very great; and the making of king posts and queen posts with joggles still greater, and the timber out of which they are made increases the expences; so that all these sundries, taken together, would be more expensive than rods nutted and screwed.

Fig. 1. Plate CXXIX. exhibits a design of a roof with struts and tie braces, calculated to span from 40 to 50 feet, according to the strength of the timbers and iron braces.

Fig. 2. represents the design of a roof constructed with struts and tie braces, calculated to span from 60 to 80 feet, according to the strength of the timbers and iron work. The tie braces are here, and in the last roof, supposed to be screwed and nutted above the rafter, and below the tie beams.

Fig. 3. shews a truss posted roof, with a king post and a pair of side posts on each side of the king post, calculated to the same extent as the last roof; but, from the number of joggle pieces between the struts, a very small degree of shrinking in each will loosen the struts, and consequently deprive them of their office of supporting the rafters and tie beam. This circumstance cannot take place in any of the former figures; and it may be farther observed, that the straps and keys which are used in this design, will go a great way towards the expence of the long iron screw bolts; and it may here be again repeated, that the trouble of forming the truss posts with square abutments at the joggles, the fitting of the iron straps, and the cutting of the mortices for the wedges, is much more trouble than the boring and screwing of the bolts. The expence of the materials of the straps and keys, and of the timber of the truss posts in this roof, would exceed that of the bolts and nuts in the last roof.

Fig. 4. exhibits a design for a roof, which may admit of an arched ceiling. The peculiarity of this roof is, that the ties extend to the lower extremities of the principals, and rise in the middle, so as to give greater elevation to the vaulted ceiling. This roof was designed and executed by Mr Revely in the church at Southampton, about the year 1797, and perhaps was the first construction of the kind in this country. The two ties are halved together at A; but the parts AB, AC perform only the office of ties, or are in a state of tension; while the parts AE and AD perform the office of struts, or are in a state of compression. The king post AF, or an iron bolt, is a necessary part of this construction, and cannot by any means be dispensed with.

ON DOMES.

Having now given some of the best forms of common roofs, we shall next proceed to domes, and show how they may be constructed under various circumstances.

If the dome be spherical, and have no lantern to support the ribs, it may be constructed of boards in two or three thicknesses, with the longitudinal joints of the boards tending to the axis of the dome, and intersecting the spherical edges, and the abutting joints intersecting the sides of the ribs which tend to the said axis. Let us now suppose the thickness of a rib to consist of three boards, and suppose the circular pieces, which are to compose the ribs, to be all prepared of equal lengths and breadths; take one of the lengths, suppose for the left hand piece at the bottom, and lap the next higher length, which is the middle piece, two thirds upon the lower piece; take another length for the right hand piece next higher, and lap this two thirds on the middle piece, so that the right hand piece will lap one third upon the left hand piece; between the ends of this third screw, spike or pin the three boards together; the middle board will want a third, the right hand board two thirds to make it complete at the bottom. These parts being supplied and fixed, lay another board at the higher end of the right hand board, the end of another to abut upon the higher end of the middle board, and the end of a third board to abut upon the upper ends of the left hand board; then there will be three plies of boards, which must be fastened together between each pair of heading joints, which are three in number. Proceed in like manner with every succeeding three boards as with the last three, until you arise to the top, and the deficiency must be supplied as at the bottom. In this manner, every rib in succession must be constructed until they are all finished. Each rib ought to be fitted to the curvature of the axal section of the dome drawn on a floor, and the three thicknesses fixed together throughout the whole length before it is removed. If, in addition to the fixing, the joints be strapped, it will add considerably to the strength, and will not be much inferior to the strength of a solid piece. In large domes of this construction, it becomes necessary to discontinue the ribs, otherwise an unnecessary quantity of timber would be employed; and it should be observed, that the greatest intervals must be so regulated in their dimensions, as not to be greater than what would make the horizontal ribs for the boarding, when fixed, sufficiently strong.

Fig. 5. is a dome of this construction. No. 1. the elevation; No. 2. an ichnographical projection. In this design, the ribs are only once discontinued, but in large works they may be twice or several times discontinued. The wall plate and kirb at the top, are framed in the same manner as the ribs.

As all domes are best boarded with their joints in vertical planes tending to the axis, horizontal pieces must, in this case, be strutted between the ribs, and their outer sides formed with the spherical surface. A dome constructed in this manner, might also be made to support a heavy lantern, provided the strutting pieces were supported together.

In the above manner, was the timber dome of the Halle du Bled at Paris, constructed by Moulineau, which is supposed to be the first of the kind.

If the boarding of the dome is required to be bent with the joints in horizontal planes, and the dome have no lantern, a very good method is to construct it with several horizontal ribs, disposed at equal angles round the axis, as their common vertex. According to the above method, between every pair of such ribs place other ribs, the curvature of which will be portions of less circles of the sphere, unless one stand in each interval, and its plane bisect the inclination of the vertical planes of the two adjacent principal ribs: dispose of these ribs in equidistant parallel planes, and fit their upper ends upon the sides of the principal ribs. This disposition of the ribs will be a considerable saving of timber, besides what it would have been had all the planes of all the ribs tended to the axis.

Fig. 6. is a design for a dome constructed in this manner: No. 1. the elevation, and No. 2. the ichnographical projection.

If the dome is required to have greater height on the exterior side of the building than can be given by employing ribs built as above, the curved part of each rib may be supported upon a vertical truss, and the intercurves of the ribs fixed to the under sides of the truss, and if a lantern is required, the better method is to place the lantern in its situation, and then to place the ribs; the curved parts which form the exterior and interior domes, will be fixed more accurately after the ribs are put up. In each of these trusses it will give much less stress to the timbers, if one of them inclines upwards its whole length from the wall-plate to the lantern, as these timbers in every truss will support the lantern of themselves, being only compressed in a direction of their length, and it should be observed, that the abutting parts on the lantern should never be on the middle of the sides; but upon the angles of the posts, and that small beams or interstices ought to be framed between the posts opposite the abutting places. These inclined timbers having a tendency to bend by the weight of the lantern, will hardly require any other trussing than what is sufficient to keep them from sagging by their own weight; and it is evident that they can only support the lantern when it is properly balanced. The lantern will therefore not be proof against the variable force of the atmosphere; a gust of wind would soon put it out of its place. If the trusses consist of two triangles, a piece of timber may be made to reach from the lower end of the lantern to the middle division of each truss; and these braces will render the lantern secure from atmospheric power. It is evident that the disposition of these pieces and the upper trussing timbers must be made to accommodate the curvature of the exterior and interior domes. The trussing might have been done without, provided the slanting timbers which support the lantern were strutted in horizontal equidistant rows, and the exterior curve might have been supported by radiating pieces.

Fig. 7. shows the lantern, and one of the trusses on each side of it. The pieces AB, AB, are two of the inclined pieces supporting the lantern; and the pieces CD, CD, secure the equilibrium against wind, or sudden impulse.

Though any elevation might be given to a dome by this last method, and the timbers might even be made so secure as to support a lantern of stone of considerable ponderosity, yet, as this material is liable to decay, and would therefore be subjected to frequent reparations, a vaulting of stone may be carried from the cylindric walls upwards, in the form of the frustum of a cone, with its axis vertical, and the lantern built upon the top of this vaulting. If the exterior dome is to be formed of timber work, the ribs may be constructed in three thicknesses, as in the Halle du Bled, or in single pieces scarfed together, and supported by posts and beams, which mutually support the extremities and bearings of each other.

The dome of St Paul's cathedral, designed by Sir Christopher Wren, is of this construction. The interior, or lower dome, consists of 18 inches brick-work, and several courses of whole brick, bonding the entire thickness of the spheric arch, at five feet distance. This dome, as we are informed, was turned upon a centre which supported itself without any standards from below; and this centering remained for the use of the painter. The interval between it and the dome was twelve feet. This dome is hooped with a double chain of iron at the base, to prevent any risk by its lateral pressure. A cone of eighteen inches brick-work supports the exterior dome, the beams being tied to stone corbels by iron cramps, which are well bedded in lead, and bolted to the beams. The stairs which lead to the golden gallery at the top of the dome, are carried up between the trusses, or between the brick cone and the external dome. The boards are bent from the base upwards to the bottom of the lantern, having their joints in planes tending to the axis. The repandous sides of the exterior dome are framed of segments of circles, which would meet, if produced in a pointed arch at the top. The brick cone supports a lantern of Portland stone, of 21 feet diameter, and near 64 feet high. The diameter of the dome is 104 feet, and there are 32 trusses in its circumference.

Fig. 8. shews the elevation of two opposite trusses, the sections of the brick dome and cone:

AB One side of the section of the interior dome.
CD One side of the section of the brick cone.
EF Repandous side of the exterior dome.

The hammer-beams are marked by the small letters *a*, *b*, *c*, &c.; and the posts by the numbers 1, 2, 3, &c.

The struts are all five inches by eight: the scantlings of the other timbers, denoted by the small letters and numbers, are as follow:

		Scantlings.		
		In.	by	In.
Hammer beams,	*a* . .	8	×	11½
	b . .	8	×	10
	c . .	8	×	10
	d . .	8	×	7½
Posts	1 . .	10	×	11½
	2 . .	10	×	11½
	3 . .	10	×	9½
	4 . .	8½	×	9½
	5 . .	8½	×	8½
	6 . .	7	×	7

The curve ribs of the dome are 10 by 11½ inches at the bottom, and 6 inches square at the top: the purlins which support the boarding are 4 inches square.

Fig. 9. shows part of the brick cone, one of the stone corbels, with part of a hammer-beam connected therewith by means of an iron strap bedded into the stone with lead, and bolted to the hammer-beam.

The construction of this dome and truss is, upon the whole, very judicious, and the timbers are well disposed.

Centerings to Arches of Bridges.

Centre, in carpentry, is a frame of timber constructed for the purpose of supporting the stones or bricks of an arch or vault during the erection.

The centre, therefore, serves as a foundation to build the arch, and is taken down, or struck, at the completion of the work.

The centre of a large vault, as that of a bridge, is constructed of trusses disposed equidistantly in vertical parallel planes, and boarded over, so that the convexity of the boarding may coincide with the internal intended concavity of the arch. The distances of the ribs may be disposed at from 3 to 8 feet, according to the strength of the boarding and the ponderosity of the arch. In very large works, a bridging is laid for every course of arch-stones, with blockings between, to keep the ring-stones at regular distances; but the ring-stones do not always rest upon these bridgings; planks are sometimes put between, that they may be cut away afterwards, and separate the centre and the intrados from each other, in order to ascertain whether there are any settlements in the arch, and to repair the damages and put the arch in a state of equilibrium.

The principle of trussing having already been given under the department of *Roofing*, little more requires to be said than a few observations upon the forms of trusses applicable to centering.

Where the river is not navigable, the trusses may be constructed with a beam at the bottom. In this case there is no difficulty; the forms for the trusses of roofs may form the grand or principal part of the truss for the centre: but when the river is navigable, the centre requires as large an opening as is consistent with its strength, in order that the vessels may pass under it, and the disposition of the timbers will require much greater skill of the carpenter.

The general principle of construction is a series of triangles, of which every two is connected by a common side.

Let ABCDEFG, Fig. 10. be the curve of the arch which requires a centre. Let the points A, B, C, &c. be connected so as to form the equilateral polygon ABCDEFG, and join AC, CE, and EG; the timbers thus disposed will form three triangles, which may be looked upon as so many solids revolvable about the angular points A, C, E, G; suppose now these to be in equilibrium, the smallest force on either side would throw it down, and therefore without other connecting timbers, it would be unfit for the purpose of a centre.

Let ABCDEFG, Fig. 11. be the curve of an arch which requires a centre; first form the equilateral polygon ABCDEFG, with the timbers AB, BC, CD, &c. and fix the timbers AC, CE, EG, as before, which will form three triangles, moveable round A, C, E, G. Let the timbers BD and DF be fastened, and thus the whole will be immutable, so that, if supported at the points A and G, and a force be applied at any other of the angles B, C, D, or F, the timbers will be all in a state of tension, or in a state of compression, and the whole may be looked upon as a solid body. For since the sides and angular points of a triangle are fixed, when the triangle is supported at two of the angles, and a force applied to the other, let us suppose the triangle ABC to be supported at the points A and B, and the point C, and the other two sides BC, CA, will be fixed; and because BCD is a triangle, and the points B and C are fixed; the point D, and consequently the sides CD and DB are fixed: in like manner, since CDE is a triangle, and the points C and D fixed, the point E will also be fixed, and also the sides DE and EC. The same may be shown in like manner for the points F and G. Suppose, then, two equal and opposite forces applied at the points A and G in the plane of the figure, the figure can neither be extended out nor compressed together. The pieces AH, HB, and GI, IF, are of no other use than to make the centre stand firmly on its base. The disposition of the timbers will cause them to occupy the least possible space.

If the timbers are fixed at the points k, l, m, n, o, p, Fig. 11, the same immutability of figure may be demonstrated; for suppose the points A and H to be fixed, the point K will also be fixed; the points A and k being fixed, the point B of the triangle A k B will likewise be fixed; again, the points B and k being fixed, the point l will also be fixed: in the same manner all the remaining points, C, m, D, n, E, o, F, p, G, I, may be proved to be stationary in respect of the points A, H; and the whole figure being kept in equilibrio by any three forces acting in the plane of the figure at any three angles, the action of the forces will only tend to compress or extend the timbers in the direction of their length.

In the construction of this truss, the triangular parts may be constructed all in the same plane, and the pieces BD and DF may be halved upon the pieces CA and EG; but the utmost care must be taken to secure the several pieces concurring at each of the angles, by bolting or iron straps, as no dependence can be put in any such joint without iron: but perhaps the best method of any is to halve the thickness of the pieces AC, CE, EG, at the points C and E, and also the pieces AB, BC, CD, DE, EF, FG, at the points B, D, F: then bolting the ends A and C of the pieces BA, BC, the end C and E of the pieces DC and DE, and the ends E and G of the pieces FE and FG, and then fixing double braces BD, DF, that is, fixing BD upon one side of the truss, and another upon the other side of the truss opposite to it, also fixing DF upon one side, and another opposite to it.

Fig. 12. represents the manner of constructing a centre according to the principles of Perronet, the celebrated French engineer, but the disposition of the timbers, forming only a series of quadrilaterals, gives nothing but immutability of figure. It can, therefore, only derive its stiffness from the resistance of the joints.

Having thus given a general account of the principles of Centering as connected with the article Carpentry, we must refer our readers to the article Bridge for its application, and other practical remarks in the constuction.

CARPESIUM, a genus of plants of the class Syngenesia, and order Polygamia Superflua. See Botany, p. 291.

CARPET, in the manufacture of cloth, is a species of woollen stuff, made of variegated colours, and used for the floor cloths of rooms.

The manufacture of carpets, we may reasonably conclude, originated in Asia, from whence most of our knowledge of the manufacture of cloths of almost every description appears to have been derived; and to this day, the finest and most expensive of the ornamental kinds are distinguished by the name of Turkey carpets. They are now, and have long been, manufactured both in France and Italy, and those used in Britain, of internal manufacture, are equal both in fabric and design to any imported. In England they are generally called Wilton carpets, from the county which is the chief seat of that and the other finer branches of the woollen manufacture. Some manufactures are, and have been long established in Scotland, of which Stirling and Kilmarnock are the chief seats, but they are generally confined to the coarser and low priced kinds.

Carpeting possesses this peculiar property, differing from almost every other kind of cloth, that it consists of two distinct webs, woven at the same time, and firmly joined together by the operation. Hence arises that common effect, that on the two sides of a carpet the form of the pattern is the same, but all the colours are reversed. The most accurate idea that can be formed of the texture of carpets, is to suppose the warps of two distinct webs to be placed in the same loom, and in contact with each other, the one being above and the other below; and that the weaver, in forming cloth, is to intersect each web with one thread of woof alternately. Were this process followed strictly, as in weaving plain cloth, two separate webs would be produced, and the operation would, of course, be much more clumsy and tedious than the common mode. Again, if we suppose that a carpet woven of double cloth were formed of lineal stripes by the warp, two distinct fabrics of cloth would be produced; but these would be intersected and joined by parallel straight lines, extending from one end of the web to the other, at distances equal to the breadth of the respective stripes. If, further, we suppose these stripes to be reversed at pleasure, and that this should be so effected as to form the whole into a succession of squares, the appearance of a tesselated pavement, or what architects and builders denominate Mosaic work, would be the result. In this the junction of the two fabrics would be more intimate than in the first, and the greater the variety of pattern, where the figures are small, the intimacy is still increased, because the webs are joined at a much greater number of points. From this a very useful deduction may be gathered by those who study durability more than ornament in the purchase of a carpet, always to select one where the figures are small, for in this case the two fabrics are always much closer interwoven than in those where large figures upon ample grounds are represented.

In an economical view, considered comparatively with other fabrics, the application of the principle of fabricating double cloths, seems judicious in various respects, when applied to carpets or floor cloths. They must possess more warmth; they may be reversed at pleasure, thus exposing alternately two surfaces differing in the arrangement of colour, although similar in pattern; and they are susceptible of more variety of figure than could be produced so cheaply on any single cloth.

In giving such an account of this sort of cloth as our limits will admit, we must confine ourselves wholly to the operation of *weaving* the cloth in this article; for the other operations, although the whole are generally practised within the same manufactory, belong to the various processes for preparing and dying woollen yarn, and will be found under the respective articles relating to these branches of the manufacture.

The carpet manufactory, as practised in every part of Europe where carpets are made, may be reduced to two kinds.

1st, Those which are woven double, and which form by far the greatest part.

2d, Those which are cut in imitation of velvet, and which being much more expensive, are only used by the most opulent persons.

Double Cloth Carpets.

If we suppose these to be composed only of two colours, the principle of weaving them may be very easily explained. It is only necessary to raise the warp of each web alternately for the passage of the shuttle, the upper web being entirely above when the under web is woven, and *vice versa*. A representation of the carpet draw loom, will be found in Fig. 1. Plate CXXX. which is a transverse section of a carpet loom, showing that part which is called the harness. In the front of these, in the real loom, are four leaves of heddles, two being allotted for each web; but as these differ in no respect from common heddles, excepting in the length of the eye, they are not represented. The form of the eye which is common both to the carpet and damask draw loom, will be seen by examining Fig. 5. In draw looms of every kind, there is no sinking of any portion of the warp, as in plain cloth; the general body of the warp is therefore placed low, and the threads under which the shuttle is to pass are raised, all the others remaining stationary. The harness part of the loom is moved by a boy or girl, placed to assist the weaver, by moving the harness whilst he inserts the woof, and works the front mounting or heddles. Fig. 4. A represents the frame work of the loom; B is a box or frame of pullies, over which the cords of the harness pass, and are then made fast to a piece of wood, which the weavers call a table, and which will be seen at E. From the tail of the harness the simples descend, and to the end of each is attached a small handle, called a bob. These handles being disposed in pairs, and their regularity preserved by means of a perforated board, it is only necessary to pull every handle in succession; the weaver, at the same time, working the treddles with his feet exactly as in any other loom. The treddles are four in number, the fabric being that of plain or alternate cloth, and two treddles allotted for each web. The harness part of the carpet draw-loom is furnished with *mails*, or metallic eyes, to avoid friction, and two threads are drawn through each eye. The design of a carpet is drawn upon cross ruled paper, exactly in the same way as every other species of fanciful loom work, and is transferred from the paper to the mounting, by rules so entirely similar to those used for damask and all the branches of ornamental weaving, that a very short description will be abundantly sufficient. It may, however, be of use shortly to advert to the general principle upon which the particular application of the harness to the weaving of carpets depends; for a little consideration of general and elementary principles must, in every art or science, prove of the greatest utility to those who wish afterwards to qualify themselves for an extensive knowledge of their particular application. Suppose that two webs then, are so mounted, that every alternate thread of the one may be raised, so as to form an ample passage for the shuttle without at all depressing the other. Then suppose another web placed above the former, at such a distance that it will exactly touch the summit of those threads of the former which are raised. Then if the threads of the latter web are sunk, while the others are raised, the two would be entirely incorporated. But if this be only partially done at particular places, only those parts immediately operated on will be affected by the action of the apparatus employed. Supposing the carpet is to consist of two colours, as green and yellow, and that on the upper surface, as stretched in the loom, yellow flowers or ornaments are to be represented upon a green ground; then all those species of design paper, which are coloured, may be supposed to represent the yellow, and those which are vacant the green. Then counting the spaces upon the paper, omit those which are vacant, and cord those which are coloured, and the effect will be produced. But as the two webs are to be raised alternately, whatever is corded for the first handle must be passed for the second, and whatever is passed for the first must be corded for the second. Thus the handles being placed in pairs, one will produce the flower, and the other the ground. Fig. 2 and 3, are profile elevations of the carpet draw-loom. Fig. 2. represents a section of the harness; the box of pullies being at B, the perforated board or regulator at C, and the suspended weights at D. In Fig. 3. the box or frame of pullies is at B, the board by which the simples are regulated appears at F, and the handles or bobs at G. In both figures, the portion of the frame work of the loom which is visible, is distinguished by the letter A.

Turkey and Wilton Carpets.

These carpets are merely woollen velvets, with variegated colours, and their principle is, in every respect, entirely the same. To form the pattern, or design, the manner of applying the cords is entirely similar to the damask draw-loom. Where the flushing is afterwards to be cut, it is common to introduce grooved wires, which serve as guides to the knife, and these may be cut out as soon as a sufficient quantity of cloth has been woven, to secure the warp from being entirely cut away from the cloth. A very great variety of hearth rugs, bottoms for chairs, stools, and other kinds of ornamental furniture, are woven upon this principle. For lobby and stair carpets, many are woven merely as plain cloth, the warp being of variegated woollen yarn, so very closely set together, and confined in the reed, as totally to cover and conceal the woof. In this case, the woof may be of slack turned hempen cordage, very thick. This not only forms a very stout and durable fabric, but from the coarseness of the hemp, gives the whole fabric the appearance of a narrow stripe, not dissimilar in effect to corduroy.

It seems somewhat singular, that no attempt should have been hitherto made to apply mechanical power to the weaving of any of the various and extensive branches of the woollen manufacture, while so many attempts have been made, hitherto without much success, in the cotton and partially in the linen. The recent invention of the cotton machinery has, no doubt, given to those employed in that manufacture, a greater acquaintance with the application of mechanical agency; and the beneficial effects of the rapid succession of improvements, must have greatly weakened that dread of innovation which operates so strongly on the human mind, especially where antiquity and long established usage have thrown a sort of veil of respect, and almost veneration, over what has passed through many successive generations, almost without alteration. The very circumstances of any art being long practised with little variation or improvement, seems to warrant a presumption, that it has already approximated as nearly to perfection as can be reasonably expected; and this sort of reasoning is certainly entitled to very considerable consideration before rash innovation is attempted. Every department, however, of the woollen manufacture, seems to present to the judicious speculator a field for further improvement, and facilities for its accomplishment, beyond any of the other branches of the cloth manufacture. The raw material of itself presents very great advantages. It is not only long and stout in the fibre, but powerfully elastic. Hence it is admirably fitted to oppose that reaction to the power of machinery, the want of which is the most powerful obstacle in the cotton, and still more so in the flax. When, to these considerations are added, that of its requiring no aid of chemical preparation, the most powerful objections to every kind of weaving by machinery hitherto attempted are at once removed, and the mechanic has nothing to impede him, provided he judiciously applies the mechanical powers in the most efficient and simple form. These considerations have induced the author of this article to pay some attention to what appeared to him an object, not only of immense national importance, but which has most unaccountably been totally neglected. In Plate CXXX. Fig. 6, 7, will be found a plan for the construction of a carpet draw loom, every operation of which is performed entirely by mechanical power, and which, instead of requiring a man and boy, performs every function of both. Consequently it would only require a casual superintendance; and perhaps a few boys, under a careful and judicious overseer, might be sufficient for a manufactory of twenty or thirty looms. Only that part is represented which is peculiar to this particular species of weaving; the other parts, which drive the shuttles and shift the boxes, being not necessarily different from any of the various plans given under that department of the article Cloth Manufacture, which treats of weaving by power, as far as regards the former, nor from the plan given for shifting the boxes from that described and represented for check and pullicate lays under the article Check. The novelty and originality of this plan, is chiefly in that part which is adapted to move the harness automatically, and even this is so very similar to what has long been successfully applied to moving the keys in the common barrel organ, as hardly to come under the description of a novelty merely speculative. The proposed loom, in order to afford the utmost possible room for every part of the apparatus, and also to be erected with a due regard to economy of expence, reaches entirely from the floor to the joisting of the shop. Thus no caps and few cross rails are at all necessary, and the whole framing consists of five strong upright posts, with only four rails for fixing and supporting particular parts of the machinery. It is obvious, that for an operative weaver renting merely a loom stance, and subject to frequent removals, a plan of this kind would be liable to serious objection; but it is hardly presumable that any company or individual would embark capital in an extensive manufactory, driven by mechanical power, without having previously secured the permanency of situation, for at least a considerable term of years. Hence economy in constructing machinery, when not injurious to its strength and efficiency, becomes a very important feature in the plan of erection. Fig. 6. is a transverse elevated section of the loom, immediately in front of the harness; the following description of which, it is hoped, will enable any person conversant with the common modes of carpet weaving, to ascertain the scope of the projected improvement. In this figure, the two back posts strongly secured to the floor and to the roof, are represented at AA; the frame or box of pullies at C; the perforated, or regulating board for the harness, is at DD; and the suspended weights which lighten the harness appear below at EE. An additional post, peculiar to the power loom, is represented at F. This post serves to secure that part of the harness which is called the tail at B, in the same way as the table does in the common carpet draw loom, and below at F, serves for one end of the axis of the barrel G, which raises the harness, and supersedes the use of a draw-boy by revolving upon its own axis. The other end of G may rest either upon a vertical or horizontal post, which is not represented. On the end of the barrel is a ratchet wheel, which may either be placed to the right, as in Fig. 6. or to the left, as in Fig. 7. If the former be adopted, the catch H may be driven merely by a stud in the pinion Y: but in the latter case, a small shaft must extend from A as far as B, and the catch may be worked by a small crank on its extremity. At the left hand of the loom, the moving power is applied. The first motion is communicated to the fast and loose pullies at L, by a belt or band from a drum or pulley at O, which takes its motion directly from the moving power, whether water, steam, or horses. The band may be guided from either pulley by the levers at MM, and the loom instantaneously set in motion or stopped, either above or below. The cross shaft at K may receive all the wipers or cranks necessary for every motion, and these may be applied according to the choice of the engineer or mechanist, as in other power looms, regard being paid to the succession in which the leaves of the front mounting are to be moved. Four treddles are represented below at NN; and in the present plans these are to be moved in the succession of the numerals 1, 2, 3, 4, so that it is supposed that one revolution of the shaft K will work the whole four treddles. The wipers here are supposed to be projecting pieces of iron, at right angles to each other, and furnished with small rollers to diminish the friction. In fabrics so stout and elastic as woollen carpets, these may do sufficiently well, or the wipers may be constructed by the rules given for power looms in the article Cloth Manufacture. These are the whole motions, and it may now be proper to recur to a more particular detail of those parts which form the peculiarities of this plan.

Construction of the Barrel.

To those who are conversant with the principle of the construction of barrels for organs, chimes, and other automatical engines, that which is necessary for a carpet draw-loom, will not appear very difficult; but for the use of mechanics who may wish to understand the principle of this machine, it may perhaps be proper to enter a little more into detail. The barrel may be hollow, and built of thick and well seasoned plank, upon rings of cast iron, wedged, or otherwise firmly fixed upon the axis, which may be either of malleable or cast iron; but the former is certainly preferable in every respect. When the cover is firmly joined by glue and countersunk screw-nails, it is to be very truly and straightly turned; and where it can be conveniently done, this operation will be better performed in the bushes or centres in which it is afterwards to revolve than elsewhere. When this has been done, it is only necessary to ascertain the places for the projecting pins; and these will be much firmer and less liable to accident, if screwed, than if driven into the cover or circumference of the barrel. In order to ascertain with precision the proper diameter of the barrel, regard must previously be paid,

1st, To the extent or number of changes required in the pattern to be formed. This will be easily found by referring to the design, as in mounting the common carpet draw-loom; for if the pattern is the same, just as many sets of forks or pins will be required for the power loom as there are bobs or handles for the common loom.

2dly, The range which is required to open the sheet each time to a sufficient depth; and this may be found by attending to the principles upon which the agency of the barrel upon the mails of the harness depends. Let us suppose, for example, that the depth of shed formed by the harness requires that the mails should be lifted three inches. Then as this is to be effected by the deviation of the tail part from the straight line, and that as one extremity of the harness only is moveable without entering into all the nicety of trigonometrical calculation, it may be assumed that the lashes will descend to raise the mails in the ratio of 2 to 1, or nearly so. If then the barrel must move six inches at every shift, a very large diameter indeed would be required for a very moderate range of pattern; and yet this, where it is practicable, will be by far the easiest and cheapest method. Taking, therefore, the shift of the barrel at six inches each, a barrel six feet in diameter would only work a pattern of about forty changes. But in more extensive patterns, the barrel must be extended to a size, which would be totally impracticable. Means must therefore be used to counteract this inconveniency, and fortunately these are simple and obvious. It is obvious, that in the way in which the lashes are fixed in the common carpet-loom, they are well calculated for their purpose; for a child will find little inconvenience in pulling a handle six inches down, but would find his strength totally inadequate to raise a great number of weights suspended to the harness, were the mechanical power against him. Upon this obvious principle it is plain, that a few small blocks placed above the barrel, to invert the power and increase the range of the mails in rising, will at once do away the inconvenience, and consequently it will be easy to reduce the size of the barrel, and increase the range of the weights in whatever ratio may be found practically convenient. Where the agency of water or steam is employed, the loss of power can be an object of no consideration; and no judicious mechanist can be at a moment's loss to construct them with any number of sheaves suited to his purpose. It is simply the apparatus employed to shorten the range of the weight which moves a common roasting jack. A few levers also might be very easily so disposed as to produce exactly the very same effect. For a cheap and simple practical substitute, large glass beads, with a proper number of smooth holes, and the cord rubbed with black lead, would do very well.

In the profile elevation, Fig. 7, not only the general appearance of the loom will be exhibited in a different point of view, but also some parts not shewn in Fig. 6. and between both every thing of consequence will be found. A recapitulation of the whole reference letters will therefore be sufficient for what appears in Fig. 6. and a short description for those which do not. AA are two of the upright posts extending from the floor to the roof, and firmly secured to both. B is the post for the barrel, and is here supposed to be fixed at the top to a cross rail, nailed or screwed to the roof. C, D, and E do not appear, being behind the post B. F is the end of the axis of the barrel appearing through the upright post, and G the barrel itself, the rachet being here placed to the left hand. H is the catch by which the rachet is pulled. I the lower part of the lashes fixed like the semples of a common draw-loom, the lashes forming a small curve, in order to ensure a constant pressure against the barrel. K and Y the wheel and pinion, by which the barrel is moved round. L, M, O, and P do not appear, the view being the opposite side of the loom. N shews one of the heddles, the wipers which move them being concealed by the wheel K. Q, the lashes. R, the pullies which support the four leaves of heddles omitted in Fig. 1, and the heddles themselves appear at S. At T is the lay and reed, at U are the rods for the two warps, and at V the double cloth. The two beams are at *a b*, and the tension of the web is preserved by two inverted balances, the lighter weights being at X, and the heavier suspended on levers at WW. The levers acting as steelyards, the tension may be increased or diminished at pleasure, merely by moving the weights.

It has been deemed unnecessary to specify particularly any way of moving the web from one beam to the other, because three different plans will be found, which are in actual use in the representations and descriptions of power-looms, given under the article CLOTH MANUFACTURE; and either of these may be applied to this loom with equal facility as to any other. It is, however, necessary, in order to complete the automatic properties of the loom, either that one of these, or some efficient substitute for them, should be adopted. The shuttle and lay motions being also common to all power-looms, are therefore totally omitted here.

The above description will probably enable an intelligent mechanic to comprehend the principles of the invention; but in this, as in all new discoveries, much improvement is always to be expected and acquired by actual trial. Its obvious utility, even as a first sketch, may render it of service to those who find it their interest to prosecute this manufacture. (J. D.)

CARPHA, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 107, and R. Brown, *Prod. Plant. Nov. Holl.* &c. p. 230.

CARPHALEA, a genus of plants of the class Tetrandria and order Monogynia. See BOTANY, p. 116.

CARPINUS, a genus of plants of the class Monœcia, and order Polyandria. See BOTANY, p. 321.

CARPOCRATIANS. See ECCLESIASTICAL HISTORY.

CARPODETUS, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 149.

CARRACCI. See CARACCI.

CARRE', LOUIS, a celebrated French mathematician, was born at Clos-Fontaine, near Nangis, in Brié, on the 26th July, 1663. His father, who was a respectable farmer, having intended him for the church, young Carré prosecuted the study of theology for three years; but, in consequence of his refusing to take orders, all his pecuniary supplies were withheld, and he was obliged to quit the university and seek for employment. In this situation, he was engaged as amanuensis to the celebrated Father Malebranche, under whom he acquired a knowledge of mathematics and metaphysics. After having filled this situation during seven years, he employed himself in teaching mathematics and philosophy at Paris. In this new employment he had several pupils of the fair sex, for whose talents he seems to have entertained a very uncommon, or rather an extravagant degree of respect, when he estimated female genius as higher than that of the other sex. The language of Carré being rather unpolished and ungrammatical, one of his fair pupils offered to give him lessons in French, in return for his philosophical instructions. Carré cheerfully accepted the offer, and often acknowledged himself greatly indebted to the instructions which he then received.

The subject of metaphysics now occupied all the leisure hours of Carré, and his mathematical studies were almost completely forgotten, till the 4th February 1699, when M. Varignon admitted him as one of his eleves in the Academy of Sciences. This new office drew his attention to mathematics, and in the year 1700 he published, in quarto, a complete work on the integral calculus, entitled, *Une Methode pour la mesure des surfaces, la dimension des solides, leur centre de pesanteur, de percussion, et d'oscillation.* This work reached a second edition, in which several errors were candidly acknowledged and corrected.

On the 15th February 1702, M. Carré was admitted Associate Mechanician, and on the 18th August 1706, he was promoted to the situation of Pensioner; the emoluments of which enabled him to devote himself entirely to his studies, but particularly to the various branches of mechanics and natural philosophy. He composed treatises on a great variety of physical subjects, all of which were bequeathed to the Academy of Sciences, though it does not appear that any of them have been published. In the forty-eighth year of his age, he was attacked with dyspepsia, which at last brought him to the grave, on the 11th of April 1711.

The following is a list of the papers which he published among the Memoirs of the Academy of Sciences:

Observations Anatomiques sur la dilatation de l'oreillette droite du cœur, Mem. Acad. 1666, tom. ii. p. 210 *Méthode pour la rectification des lignes courbes par les tangentes*, 1701, p. 159, hist. 83. *Solution du probléme proposé aux Géomètres dans les memoires de Trevoux, des mois de Septembre et d'Octobre*, 1701, 1702, p. 268, hist. 85. *Reflexions ajoutées par M. Carré à la Table des Equations*, 1701, hist, 111. *Obs. sur la cause de la refraction de la lumière*, 1702, hist. 11. *Pourquoi les marees vont toujours en augmentant depuis Brest jusqu'a Saint Malo, et en diminuant le long des côtes de Normandie*, 1702, hist. 19. *Nombre et noms des instrumens de musique*, 1702, hist. 136. *Obs. sur le vinaigre qui fait rouler de petites pierres sur un plan incliné*, 1703, hist. 21. *Obs. sur la rectification des caustiques par reflexions formées par le cercle, la cycloïde ordinaire, et la parabole, et de leurs développées, avec la mesure des espaces qu'elles renferment*, 1703, p. 183, hist. 69. *Méthode pour la rectification des courbes*, 1704, p. 66, hist. 44. *Observation sur ce qui produit le son*, 1704, hist. 88. *Examen d'une courbe formée par le moyen du cercle*, 1705, p. 56. *Exp. physiques sur la refraction des balles de mousquet dans l'eau, et sur la resistance de ce fluide*, 1705, p. 211. *Exp. sur les tuyaux capillaires*, 1705, p. 241, hist. 21. *Probléme d'hydrostatique sur la proportion des tuyaux pour avoir une quantité d'eau déterminée*, 1705, p. 275, hist. 135. *Des loix du mouvement*, 1706, p. 442, hist. 124. *Démonstrations simples et faciles de quelques propriétés qui regardent les pendules, avec quelques nouvelles propriétés de la parabole*, 1707, p. 49, hist. 58. *De la proportion qué doivent avoir les cylindres pour former par leurs sons les accords de la musique*, 1709, p. 47, hist. 93. *Exp. sur le ressort de l'air* 1710, p. 1. hist. 1. *Desc. d'un ver enfermé dans une coque d'une ligne de diametre, et qui ne cesse de sautiller quand on l'expose au soleil*, 1710, hist. 42. *Abrégé de catoptrique*, 1710, p. 46. hist. 112. *Monochorde*, *Mac*. t. 1. p. 101. (*o*)

CARRIAGE.

Carriage, a general name given to all vehicles used with wheels, for the conveyance of any weight, goods, or passengers; but now more commonly applied to those for the latter purpose, such as coach, chaise, &c. In this sense carriages are of undoubted antiquity. They are frequently mentioned under the name of chariots in the Old Testament. Chariots were in use in Greece, particularly at the Olympic games.

The Romans used carriages of different kinds, and under different names. The *arcera* is mentioned in the 12 tables; the *lectica* followed; then the *carpentum*, and still later the *carruca*, which last was considered a first-rate machine, and often highly ornamented with gold and precious stones. After these, covered carriages of various kinds were used as appendages of Roman pomp and grandeur, until the manner of thinking which prevailed under the feudal system banished them for a time. Indeed so early as the reign of Julius Cæsar, carriages were even let to hire in Rome, as appears from Suetonius, who, speaking of that emperor, says, *Longissimas vias incredibili celeritate confecit, expeditus, meritoria reda, centina passuum millia in singulos dies.* (See *Suetonius*, lib. i. cap. 57.) In latter times, it would be difficult to say at what precise period, of what kind, or in what nation, carriages were again introduced. Historians appear to have taken little interest in them, as few have mentioned them at all, and those few but slightly; nor ought we to be surprised at this, when we consider the low state of mechanical arts, the little intercourse between neighbouring powers in mercantile matters, and the necessity, in feudal times, of princes having their lords and vassals trained up in the use of arms, and, of course, not indulged in any thing bordering upon luxury or effeminacy. In this state of things there was hardly an opening for carriages, as kings, lords, and commoners, all rode on horseback; and even the women and the clergy had no other mode of conveyance, except on mules or asses. Indeed so strong was the prejudice against carriages, that edicts were published prohibiting their use, at the same time that they were sometimes allowed, by special favour, to invalids, and women of the highest rank. No wonder then that historians should not accurately detail the introduction of carriages, which their princes beheld with a jealous eye, considering them as fit only to enervate their vassals, and of course weaken their own power; and which it is hardly possible they could divine, should, at some future period, become not merely of utility, but of absolute necessity; affording the chief means of internal intercourse betwixt place and place to the inhabitants of almost the whole civilized world, and their manufacture furnishing employment to thousands.

It would appear from an ordinance of Philip the Fair of France, issued in 1294, for suppressing luxury, that carriages were known at that time in Paris, as the citizens' wives were therein forbid the use of carriages (cars.) About the end of the thirteenth century, when Charles of Anjou made his entrance into Naples, the queen rode in a carriage called at that time *caretta*, the outside and inside of which were covered with sky blue velvet, interspersed with golden lilies. The Emperor Frederick III. seems to have used a close carriage in his journies to Frankfort in 1474-5. The Electress of Brandenburgh, and Duchess of Mecklenburgh, and some others, displayed elegant carriages in 1509. In 1550 there were in Paris three coaches, said by some to have belonged to the queen, to Diana de Poictiers, and to Rene de Laval, Lord of Bois Dauphin, who was such a corpulent and unwieldy nobleman as to be unable to ride on horseback. Others say the three first carriages belonged to Catherine de Medicis, Diana Duchess of Angouleme, who died 1619, and Christopher de Thou, first president of the Parliament. Henry IV. was assassinated in a coach; and he appears to have had one only, from a letter he writes to a friend, in which he says, "I cannot wait upon you to-day, because my wife is using my coach." (*Varietes Historiques*, p. 92.)

Roubo, in his voluminous Treatise on Joiner Work, has given drawings of carriages such as were used in the time of Henry IV. From these drawings we see, that there were neither straps nor springs in use at that period. From the same work it would appear, that the coach in which Louis XIV. made his public entry, was hung upon straps without springs; and there are also given several drawings of carriages with springs. (*L'Art de Menuisier, Carrossier*, par M. Roubo le Fils; See *Description des Arts et Metiers*, fol. 1770, vol. x. p. 453.) In 1562, the Elector of Cologne had several carriages. In 1594, the Margrave John Sigismund had, at Warsaw, 36 carriages, with six horses each, (*Suite des Memoires pour servir a l'Hist. de Brandenburg*, p. 63.) where, the royal author adds, "the common use of carriages is not older than the time of John Sigismund."

In *The Triumph of Maximilian*, a work executed in the years 1516, 1517, and 1518, the curious reader will find plates of various carriages or cars, some drawn by horses, some by stags, some by camels, others impelled forward by means of different combinations of toothed wheels, worked by men. Of one of the most remarkable of them, we have given an exact copy, in Plate CXXXI.; and we are inclined to think that the idea of the walking crane may have been taken from this vehicle.

Amongst other things described of the marriage of the Emperor Ferdinand II., it is said by Count Kevenhiller, that "the bride rode with her sisters in a splendid carriage studded with gold, her maids of honour in carriages hung with black satin, and the rest of the ladies in neat leather carriages."

In 1523, a law was enacted in Hungary to prevent the use of carriages. There was also a curious document published by Duke Julius of Brunswick, in 1588, forbidding his vassals the use of carriages, which is in substance as follows: "As we know from ancient historians, from the annals of heroic, honourable, and glorious achievements, and even by our own experience, that the respectable, steady, courageous, and spirited Germans were heretofore so much celebrated among all nations, on account of their manly virtue, sincerity, boldness, honesty, and resolution, that their assistance was courted in war, and that in particular the people of this land, by their discipline and intrepidity, both within and without the kingdom, acquired so much celebrity, that foreign nations readily united with them; we have for some time past found, with great pain and uneasiness, that their useful discipline and skill in riding, in our electorate county and lordship, have not only visibly declined, but have been almost lost, (and no doubt other electors and princes have experienced the same among their nobility); and as the principal cause of this is, that our vassals, servants, and kinsmen, without distinction, young and old, have dared to give themselves up to indolence, and to riding in coaches, and that few of them provide themselves with well equipped riding horses, and with skilful experienced servants, and boys acquainted with the roads; being not able to suffer any longer this neglect, and being desirous to revive the ancient Brunswick mode of riding, handed down and bequeathed to us by our forefathers, we hereby will and command, that all and each of our before-mentioned vassals, servants, and kinsmen, of whatever rank or condition, always keep in readiness as many riding horses as they are obliged to serve us with by their fief or alliance, and have in their service able, experienced servants, acquainted with the roads; and that they have as many horses as possible, with polished steel furniture, and with saddles proper for carrying the necessary arms and accoutrements, so that they may appear with them when necessity requires: We also will and command our before-mentioned vassals and servants, to take notice, that when we order them to assemble, either altogether or in part, in times of turbulence, or to receive their fiefs, or when on other occasions they visit our court, they shall not travel or appear in coaches, but on their riding horses," &c. (Lunig. *Corp. jur. feud. Germ.* ii. p. 1447.) Nor was Duke Julius the only great lord that attempted to suppress the use of carriages, for Philip II. Duke of Pomerania Stetten, tried the same thing in 1608.

All these orders, however, proved ineffectual; for about the end of the 15th century, emperors, kings, and princes, began to employ covered carriages in journeys, and afterwards on public solemnities, thereby setting an example, which, in the course of the 16th century, was generally followed.

Early in the beginning of this period, covered carriages appear to have been used by women of high rank, while yet the men considered it as unbecoming to indulge themselves in such a luxury. Ambassadors appeared in coaches for the first time in 1613, at the imperial commission held at Erfurth. (Ludolf. *Electa juris publici*, v. p. 416. *Von Mosers Hofrecht*, ii. p. 337.) The wedding carriage of the first wife of the Emperor Leopold, a Spanish princess, cost, with the harness, 38,000 florins. (Kink, *Leben k. Leopold*, p. 607.) The coaches used by that emperor, are thus described by Kink: "In the imperial coaches, no great magnificence was to be seen; they were covered over with red cloth and black nails. The harness was black, and in the whole work there was no gold. The pannels were of glass, and on this account they were called the imperial glass coaches. On festivals, the harness was ornamented with red silk fringes. The imperial coaches were distinguished only by their having leather traces; but the ladies in the imperial suite were obliged to be contented with carriages, the traces of which were made of ropes." Twiss says, that coaches were seen for the first time in Spain, in the year 1546. In 1681, there was a magnificent display of carriages in Hanover, belonging to the Duke Ernest Augustus, who had fifty gilt coaches, with six horses to each. (*Lunings Theatr. cer.* i. p. 289.) In the beginning of the 17th century, there were elegant coaches in Russia. (*Essai sur la Bibliotheque de l'Academie des Sciences de St Petersburg*, par J. Baemiester, 1776, 8vo. p. 38.)

Carriages appear to have been very early in use in England. For it is said in the life of St Erkenwald, who died about the year 685, "*Quadam verò die, verbi Dei pabula, commisso sibi gregi, ministraturus, dum duarum rotarum ferretur vehiculo, infirmitate præpediente, vel senio, contigit ut altera rotarum semitis difficultate axem relinqueret, et ibidem sociâ relictâ remaneret.* (See Sir William Dugdale's *History of St Paul's Cathedral*, fol. Appen. p. 5.) In Brook's *Catalogue of Kings, Princes, &c.* p. 67, he says, speaking of William, third Earl of Derby, "this William dyed of a bruise, taken with a fall out of his coach, in the yeare 1253, the 38th of King Henry the Third." We find in Stowe's *Summarie of the English Chronicles*, p. 287, the following notice taken of carriages: "This yere Walter Rippon made a coche for the Earle of Rutland, which was the first coche that ever was made in England since, to wit, in anno 1564. The said Walter Rippon made the first hollow turning coche, with pillars and arches, for her Majesty, being then her servant. Also, in anno 1584, a chariot throne, with foure pillars behinde to beare a canopie, with a crowne imperiall on the toppe, and before two lower pillars, whereon stoode a lion and a dragon, the supporters of the armes of England." Stow, in his *History of London*, (fol. p. 70.), says, "The oldest carriages used by the ladies of England, were called *whirlicotes*, and that they were in fashion but for a short time." And Anderson, in his *History of Commerce*, (vol. iv. p. 180.), says, "That coaches were first brought to England, in 1580, from Germany, by Fitz-Allan, Earl of Arundel."

In 1598, the English Ambassador came to Scotland in his coach. (Scott's *History of Scotland*, p. 551.) Anderson says, coaches began to be in common use in England in 1605. In 1610, one Henry Anderson, an inhabitant of Trail Sound, or Stralsund, in Pomerania, offered to bring from that country to Scotland, coaches and waggons, with horses to draw, and servants to attend them, provided he was secured in the exclusive privilege of keeping them. Accordingly, a royal patent was granted to him, conferring an exclusive privilege for fifteen years, of keeping coaches to run betwixt Edinburgh and Leith. (*Privy Seal Record*, Book 79, p. 225.) It would appear from this, that it was only for these towns that coaches were then intended. Coaches and six were introduced into England in 1619, by Villiers, Duke of Buckingham, (*Northumberland Household Book*, p. 448; Wilson's *Life of James*, p. 130); this was considered such a piece of vanity, that the Duke of Northumberland appeared immediately afterwards with eight horses in his coach by way of ridicule.

The first coach that was seen in Sweden, was taken there the end of the sixteenth century by John of Finland, upon his return from England (*Dalin*, *Geschichte des reichs Schweden, ubersetzt von Dahnert*, iii. i. p. 390 and 402). Public carriages were first introduced to let for hire in France in 1650, by Nicholas Sauvage. These carriages took their name from the residence of the proprietor, who lived in a house called Hotel St Fiacre, and were thence called *fiacres*. Others followed Sauvage in this employment, and obtained licence for letting carriages upon paying a certain sum of money. Among others, Charles Vilerme paid into the king's treasury 15,000 livres, for the exclusive privilege of keeping coaches for hire within the city of Paris. Shortly after this coaches were kept, such as the hackney coaches of the present day, standing at certain places in different streets, to go from one part of the city to another. The name *fiacre* became soon applied solely to them; the appellation of *Carosses de Remise* being given to those that were kept at the proprietors houses, and let out to hire for a certain time. And in 1662, carriages with four horses were kept for the purpose of carrying people to the different palaces at which the court might be. These went under the name of *Voitures pour la Suite de la Cour.* Regulations were established by the police to secure the safety of public carriages, and marks affixed upon them, whereby they might be known. A full history of the Parisian fiacres, and the orders respecting them, may be seen in *Continuation du traite de la Police*, Paris, 1738, fol. p. 435; and also *Hist. de la Ville de Paris*, par Sauval, i. p. 192. Coaches to be let for hire were first established in London in 1625, amounting at that time to twenty. These stood at the principal inns, and were called hackney coaches, from their being first used to go betwixt London and Hackney. Ten years after they became so numerous, that Charles I. issued an order limiting their number. In 1637, there were in London and Westminster fifty coaches. In 1652 their number had increased to two hundred. In 1654, there were three hundred. In 1661, four hundred were licensed at 5*l.* sterling annually for each. In 1694, they were limited to seven hundred. In 1715, to eight hundred. In 1768, there were one thousand; in 1802, they were increased to 1100; and they are now considerably above that number. Hackney coaches were first established at Edinburgh in 1673, at which time there were twenty. (Arnot's *Hist. of Edinb.* p. 597.) In 1679, at the rebellion, the hackney coach horses of Edinburgh were employed to draw the royal artillery. (Maitland's *History*, p. 338; Wodrow's *History*, vol. ii. p. 52.) In 1752 they had decreased to fourteen, and in 1778 to nine. (Arnot's *History*, p. 598.) Since that period, however, in consequence of the improvements in the various streets, whereby their use has become more general, the great enlargement of the city, and the increasing wealth of the inhabitants, their numbers have been gradually increasing, till now there are very nearly one hundred hackney coaches. Fiacres were first introduced at Warsaw in 1778. In Copenhagen, about the same time, there were one hundred hackney coaches. (*Haubers Beschreibung von Copenhagen*, p. 173.) There were in Madrid at that time from four to five thousand gentlemen's carriages; (Twiss's *Travels through Spain and Portugal.*) In Vienna, three thousand gentlemen's carriages, and two hundred hackney coaches. In 1663, coaches with wheels were forbidden at Amsterdam, being considered destructive to the pavements; (*Handvesten von Amsterdam*, ii. p. 739.) but about 1775 their number had increased so much, that there were twenty-five thousand coach horses in the seven united provinces.

The following statements of the number of carriages in England, Scotland, and Wales, in 1807, the progressive increase or decrease for the twenty years preceding, with the number of carriages actually made in 1804, 1805, 1806, and 1807, may be interesting to our readers. They are taken from the Appendix to the Report from the Committee on the Acts now in force regarding the use of broad wheels, and on the preservation of the turnpike roads and high ways of the kingdom, printed by order of the House of Commons, 2d May 1809; and are therefore completely authentic documents. We also subjoin a statement of the number of four and two wheeled carriages charged with the duty in Scotland, from 25th March 1747, when the duty commenced, until the present time; distinguishing, as far as possible, the private from the public carriages; and also the number of taxed carts from 1798, the period from which the duty upon them commenced.

An account of the number of Wheel Carriages in England and Scotland respectively, distinguishing Gentlemen's Carriages, Stage Coaches, and other Carriages let to hire, for the year 1806, *ended the 5th April* 1807.

	England, Wales.	Scotland.	Total.
Carriages with four wheels kept for private use	14,018	1,058	
Ditto, kept to be let to hire in such manner that post-horse duty is not payable . . .	232	5	
Stage coaches and post-chaises	5,725	517	
Total number of four wheeled carriages	19,975	1,580	21,555
Carriages with two wheels drawn by one horse	21,874	733	
Ditto drawn by 2 or more horses	1,480	28	
Taxed carts	19,250	412	
Total number of two wheeled carriages	42,604	1,171 [*]	43,775
Grand total of four-wheeled and two-wheeled carriages . .	. .	. .	65,330

An account of the progressive Increase or Decrease of Wheel Carriages within the last twenty years.

	Four-wheeled Carriages.	Two-wheeled Carriages	Taxed Carts.
Return for 1788, England and Wales only	18,129	8,393	
No subsequent return was made to the Tax-office till 1798, which includes Scotland	19,780	13,998	17,231
For 1799	17,942	12,549	16,544
1800	17,992	14,771	16,968
1801	18,428	16,233	16,711
1802	19,198	18,743	18,415
1803	19,818	20,508	19,026
1804	20,304	21,641	20,869
1805	21,117	23,004	19,652
1806	21,555	24,115	19,662
1807	21.929	24.984	19,743

A Table of the returns for duties on Carriages made for sale in the years 1804, 1805, 1806, 1807.

Carriages.	1804.		1805.		1806.		1807.	
	England and Wales.	Scotland.	England and Wales.	Scotland.	England and Wales.	Scotland.	England and Wales.	Scotland.
Four Wheeled.	1042	52	1384	126	1535	94	1509	84
Two Wheeled,	652	43	1049	89	1374	75	1168	86

An Account of the number of Four and Two Wheeled Carriages in Scotland charged with duty from 25th March 1747 *ta 25th May* 1812; *and of Taxed Carts from 5th April* 1798 *to 25th May* 1812.

Years.	No. of Four Wheeled Carriages.	No. of Two Wheeled Carriages.	Years.	No. of Four Wheeled Carriages.	No. of Two Wheeled Carriages.
1747	123	354	1769	821	266
1748	114	455	1770	866	293
1749	105	361	1771	949	290
1750	111	443	1772	933	262
1751	99	449	1773	1027	312
1752	84	497	1774	1101	312
1753	99	553	1775	1127	333
1754	87	507	1776	1165	306
1755	105	556	1777	1268	335
1756	161	625	1778	1298	331
1757	184	714	1779	1242	330
1758	225	634	1780	1208	326
1759	321	707	1781	1238	342
1760	322	512	1782	1222	350
1761	396	462	1783	1319	338
1762	432	453	1784	1292	327
1763	488	385	1785	1383	324
1764	565	357	1786	1366	301
1765	647	330	1787	1239	287
1766	697	288	1788	1271	274
1767	781	293	1789	1425	350
1768	764	277	1790	1415	334

Years.	No. of Four Wheeled Carriages.		No. of Two Wheeled Carriages.	No. of Taxed Carts.
	Private.	Public.		
1791	956	469	297	
1792	952	465	280	
1793	951	452	258	
1794	956	468	234	
1795	969	446	213	
1796	957	436	213	
1797	971	448	230	
1798	956	442	258	
1799	918	441	284	228
1800	896	450	277	252
1801	949	449	325	302
1802	944	433	432	313
1803	995	462	560	350
1804	1056	500	602	378
1805	1045	504	626	371
1806	1049	496	688	383
1807	1066	522	761	412
1808	1103	535	940	378
1809	1117	530	976	372
1810	1147	530	1019	372
1811	1190	541	1107	371
1812	1211	517	1116	354

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[*] Error of two in the printed Report.

Carriages have improved in their construction, and increased in variety, in a greater proportion than in numbers. The improvement in their construction may be imputed to the distribution of labour in building them, to the long experience of the workmen in their several departments, to the emulation naturally arising amongst the people employed in their manufacture; but chiefly to mechanics having become more a study, and of course better understood amongst all ranks of society than formerly. Carriages have been, like every other invention of man, improving slowly but gradually; and even now, when for beauty, elegance, lightness, and strength, human ingenuity would seem to be exhausted, experience leads us to look forward to something more perfect than we have yet seen; and we are warranted to expect this from the various improvements appearing from all different quarters, in almost every separate department of coach-making. We shall conclude this article with a list of patents granted for the several improvements in wheel carriages within the last ten years; and to which we refer our readers, if desirous of more information than our limits enable us to afford.

The variety in carriages is so great, that it is almost impossible to enumerate them, arising in a great measure from the increasing wealth of the people enabling them to gratify their improved taste; but more particularly, we should imagine, from a desire in the makers to raise their own reputation, by attracting the notice of the public with a name that had not been before heard of, although the carriage they produced under such name, differed very immaterially from others that had been long perfectly well known. We shall content ourselves by giving the names of those most generally known and used, with a very short description of each, leaving out of view the varieties hinted at above.

Carriages may naturally be divided into two classes: four-wheeled, and two-wheeled. The chief of these are,

Coach.—A close-bodied carriage, made generally to hold six, sometimes only four people in the inside, one half sitting opposite to the other, face to face, a window in the door on each side, and a large one, or two small ones, in front, having four wheels, and drawn by one or more pairs of horses, drove by the coachman from a coach box in front of the body. When the driver rides on horseback, they are called post coaches. Under this description may be included all mail and stage coaches, which have nothing particularly to characterise them but their uncommon strength. See Plate CXXXII. Fig. 1.

Vis a vis, made after the fashion of a coach, and in every respect like it, but only to hold two people within, sitting opposite, as the name indicates. It is drawn by two horses a-breast, and driven as a coach.

Landeau, made exactly to resemble a coach, with the same accommodation, but having the top or roof, upper part of the sides, and back, to open and fold down to the front and back, leaving to the passengers a free view of every thing around; drawn and driven as a coach.

Landeau Barouch, made in all respects like the landeau, but curved away with an inverted sweep in the under part and front of the body, by which means there is no space for an inside box under the front seat. This carriage is also drawn and driven as a coach. See Plate CXXXII. the dotted line in Fig. 1.

Barouch. The body is made the same with the under part of the landeau barouch, (sometimes like the under part of a coach body,) not having any frame work above the elbows of the passengers, and of course no glasses. On the back half of the body is put a roof similar to the roof or hood of a two-wheeled chaise, to fold up or down at pleasure, and a leather cover made to go over the cushion of the front seat, at such a height, only, as to admit the feet of the persons who sit on the hind seat being put up betwixt the cushion and leather cover. When this leather cover is not used, one or two people (according to the size of the carriage) can sit upon the front seat. These carriages are sometimes made with doors, and sometimes with leather only, to fill up the space left to enter at. Barouches are drawn by one or more pairs of horses, and driven sometimes from a coach box, and sometimes the front part of the body is formed into a seat for the driver.

Post-chaise, a close-bodied carriage, made to hold three people in the inside, looking all forward, with two windows in front, and one in the doors on each side, with four wheels, and drawn by one or more pairs of horses. The driver rides on horseback.

Chariot, exactly the same with a post-chaise; only accommodated with a coach-box for the driver.

Landeaulet, made similar in every respect to a post-chaise, but with the advantage of a moveable roof, like a landeau, which folds back so as to leave the passengers quite free. This may be put up and down by the people inside of the carriage at pleasure. See Plate CXXXII. Fig. 2.

Phaeton, an open bodied carriage, made to hold two or three people, looking all forward, with four wheels, drawn by one or more pairs of horses, with or without a folding leather roof to cover the seat part, and a leather cover to enclose the knees of the passengers, called a knee-flap. This carriage may be driven by the person sitting inside, from a coach-box, or the driver may ride postilion.

Curricle, an open-bodied carriage, similar in the body to a phaeton, drawn by two horses a-breast, having two wheels, and either with or without a roof, as above. It is driven by the person who rides in the carriage.

Two-wheeled chaise, an open-bodied carriage, also similar to that of a phaeton, but drawn by one horse, with two wheels, having a leather roof, knee-flap, &c. and driven by the person who rides in it.

Gig, an open carriage similar to the last mentioned, but without a roof, driven in the same way. See Plate CXXXII. Fig. 3.

There is a great variety of carriages besides these, such as, in four-wheeled carriages, berlins, Calash's chaise Marine's, sociables; and in two-wheeled carriages, dog-carts, buggies, tandems, mail carts, Tilburghs, Irish cars, Windsor chairs, &c. and coach and chaise bodies, have of late been constructed upon two wheels; besides many others, which may be considered more as modifications of those already described, than as different carriages in themselves.

List of Patents granted for Improvements in Carriages, from January 1802 *to July* 1812.

	Dates of Patent.	Persons Names.	For what obtained.	Volume and page of *Repertory*.
1	6. Feb. 1802.	Charles Mercie, Bath	Improvement in carriage windows	Vol. 16, p. 359.
2	27. Feb. 1802.	John Lewis, Middlesex	Preventing accidents in carriages	Vol. 23, p. 6.
3	27. Feb. 1802.	Rich. Pottinger, Middlesex	Disengaging horses from carriages	Vol. 19, p. 96.
4	9. March 1802.	Obediah Elliot, Lambeth	Curricle spring-bar	Vol. 16, p. 430.
5	24. March 1802.	P. J. Meyer, Middlesex	To prevent accidents in carriages	Vol. 16, p. 431.
6	24. March 1802.	John Williams, Portsmouth	Disengaging horses from carriages	Vol. 17, p. 86.
7	5. May 1802.	G. F. Bauer, London	Improvement of carriages and wheels	Vol. 17, p. 250.
8	26. June 1802.	James Tate, Middlesex	Improvement in addition to carriages	Vol. 23, p. 168.
9	25. Nov. 1802.	Thos. Dawson, Middlesex	Improved carriage lamps	Vol. 18, p. 401.
10	29. Nov. 1802.	James Roberts, Portsea	For locking of carriage wheels, &c.	Vol. 18, p. 160.
11	20. Jan. 1803.	Joseph Jacobs, Middlesex	Metal boxes for axletrees	Vol. 19, p. 170.
12	4. Aug. 1804.	John Brown, of Poole	Improvement on wheels	Vol. 21, p. 327.
13	25. April 1805.	Thos. Rowntree, Surrey	Improved axletree and box	Vol. 23, p. 330.
14	11. May 1805.	Obediah Elliot, Lambeth	Improved four-wheeled carriages.	Vol. 28, p. 87.
15	27. May 1805.	Samuel Miller, Middlesex	Better accommodation of passengers	Vol. 23, p. 160.
16	9. Aug. 1805.	William Collins, Plymouth	Ventilating carriages	Vol. 23, p. 400.
17	16. Nov. 1806.	Wm. Milton, Southampton	For safety to stage coaches	Vol. 25, p. 172.
18	2. Oct. 1806.	W. Cooke, of Wilts	Improvements on axletrees	Vol. 26, p. 5.
19	7. March 1807.	J. Houlditch, Longacre	Improved four-wheeled carriages	Vol. 26, p. 399.
20	21. April 1807.	J. F. Dalton, Holborn	Improved four-wheeled carriages	Vol. 26, p. 464.
21	5. May 1807.	R. Cabanal, Lambeth	Improvement in oiling, &c.	Vol. 27, p. 80.
22	21. July 1807.	C. L. Birch, London	Improvements in roofs of open carriages	Vol. 27, p. 240.
23	9. Dec. 1807.	John Williams, London	Improvement in covering carriages	Vol. 28, p. 255.
24	19. Dec. 1807.	John Williams, London	Preserving the equilibrium of carriages	Vol. 28, p. 345.
25	4. Feb. 1808.	John Drunbell, Lancaster	Preventative against overturning	Vol. 28, p. 383.
26	23. Jan. 1809.	Edward Stracey, London	Improved perch and perch bolt	Vol. 30, p. 287.
27	26. Sept. 1809.	Benjamin Flight, London	Improved axletree and box	Vol. 33, p. 141.
28	2. Nov. 1809.	Joseph Bramah, Pimlico	Improved wheels and locks for do.	Vol. 32, p. 126.
29	6. Nov. 1809.	D. M. Randolph, London	Improved construction of carriages	Vol. 32, p. 193.
30	12. Feb. 1810.	George Wyke, Bath	Improved construction of carriages	Vol. 32, p. 318.
31	26. Feb. 1810.	C. Le Caan, Llanelly	Improved method of stopping carriages	Vol. 33, p. 4.
32	8. June 1810.	John Williams, London	Rendering carriages more safe and commodious	Vol. 33, p. 215.
33	17. Sept. 1810.	Jonathan Varty, Liverpool	Improved axletrees	Vol. 34, p. 1.
34	9. March 1811.	John Collinge, Lambeth	Improved axletrees and boxes	Vol. 36, p. 133.
35	14. March 1811.	T. W. Cooper, Middlesex	For safety in travelling carriages	Vol. 34, p. 390.
36	11. April 1811.	John Taylor, Greenwich	Improved wheels	Vol. 35, p. 64.
37	1. May 1811.	G. A. Thompson, London	Improved drags	Vol. 35, p. 128.
38	7. Aug. 1811.	H. R. Brown, Edinburgh.	Improved carriages, wheels, & axletrees	Vol. 35, p. 317.
39	7. Aug. 1811.	William Taylor, Gomersall	For stopping carriages	Vol. 35, p. 318.
40	14. Sept. 1811.	Edw. Silvester, Rochester	Improved skid or drag	Vol. 35, p. 320.
41	15. Oct. 1810.	John Wheatley, Greenwich	Improved axletree and boxes	Vol 35, p. 384.
42	6. Feb. 1812.	Wm. Palmer, Blackfriars	Addition to wheels and axles	Vol. 36, p. 318.
43	25. June 1812.	Benjamin Black, Middlesex	Improvement in carriage lamps	Vol. 37, p. 128.
44	28. July 1812.	John Bellingham, Down	Improved axles	Vol. 37, p. 255.

N. B.—The dates of the patents are taken from the Repertory of Arts, and in general the specifications may be seen by referring to the volume and page of that work, stated in the last column of the Table.

For an account of the method of manufacturing carriages, see the article Coachmaking. (*v*)

CARRICKFERGUS, formerly Knockfergus, from *Kneckogh*, an adjacent hill, and Fergus the founder, an ancient town of Ireland, in the county of Antrim, situated on the north side of the large bay to which it gives name. It was founded about 320 years before the birth of Christ, by Fergus, the first king of Scotland, the cause of whose coming to Ireland is said to be this: Being afflicted with a leprosy, he dreamed, that if he bathed in a well at this place, he would immediately recover: he instantly repaired hither, and his dream is said to have been fulfilled. The same tradition says, he founded the castle, and adds, that this was the well inside the castle, which is now dry. The town is pleasantly situated along the shore, and has of late assumed something of a thriving appearance; it has, however, little trade, having sold its privileges to the inhabitants of Belfast. The houses are built mostly of stone, and commonly two or three stories high. All the streets, except the main street, are narrow, and kept remarkably dirty. The number of inhabitants, in 1810, was about 4000. It does not appear to have been a place of much importance till the arrival of the English about the year 1178, when Hugh de Lacy repaired, or rather founded, the castle, and placed a strong garrison in it to overawe the adjacent country. The town appears to have been anciently a place of great strength, encompassed with a wall and wet ditch, having four gates, some of which were entered by draw-bridges, and flanked with bastions twenty feet high; but being commanded by the adjacent hills, it never could have held out any length of time since the invention of artillery. The castle stands on a rock projecting into the sea, commanding the entrance of Belfast Lough, or, as it is frequently called, Carrickfergus Bay, which is as safe and spacious as any in Ireland, a few in the west excepted. The entrance into it is bold, being about five miles wide, and having from 12 to 20 fathoms depth of water, which grows gradually shallower till you advance opposite the town, where it is from 5 to 8 fathoms deep in the middle of the road. It grows narrow by degrees from the mouth to the bridge of Belfast, where it is not more than three-fourths of a mile broad, and from 9 to 13 feet deep at full tide: (See the article Belfast.) From this shallowness, Carmoil Pool is used as the harbour for ships trading to that town, in which 20 vessels may ride afloat at low water, though within a cable's length small barks lie around them almost dry. In this bay there are few rocks or shoals, except a reef of rocks running out into the sea for three or four hundred yards from the north side of it, called the Briggs; and, except some foul ground and a dangerous sunk rock on the county of Down side, lying between the Copeland islands (on one of which is a light-house) and Donaghadee, called the Deputy Rock, there is also, a little south-west of Carrickfergus, one shoal, on which lie 3 fathoms water at ebb tide, in the middle of the bay. The entrance into the castle is between two towers, or half moons, mounting several pieces of cannon; and over the gateway is a portcullis, and apertures for throwing down stones, and otherwise annoying the enemy. In the inner yard is a high square tower, the walls of which are nine feet thick: the lower part is bomb-proof, and serves as a magazine. In 1794, the castle was repaired, and 27 pieces of ordnance mounted on the batteries; since that time it serves as the principal magazine to the northern district. The garrison, however, seldom exceeds fifty or sixty men. The salary of the governor is about 500*l.* per annum. At the head of the main street stands the county of Antrim court-house, a handsome building, where the assizes of that county are held twice a year; and adjoining to the court-house is the county-prison. The market-house stands near the centre of the town, and is a tolerable building. The market is held every Saturday. The custom-house stands near the quay, which, although built within these few years, does not deserve the name of a public building. The quay, however, has been lately much improved. There are only two houses for public worship, an established church, and a Presbyterian meeting-house. The church is an ancient building, dedicated to St Nicholas, having in the north aisle an old monument of the Donegal family. The east window is of stained glass, representing John baptizing in Jordan. There are two free schools, one of which is solely supported by E. D. Wilson, Esq. the present respectable mayor, and the other by the gentlemen of the town and neighbourhood. The town has been a corporation since the days of Queen Elizabeth, who granted the charter to Arthur Chichester, then governor, which was afterwards confirmed, with many additional privileges, by James I. The government of the town is vested in a mayor, recorder, sheriffs, aldermen, and burgesses; and the corporation, under the act of union, returns one member to the imperial parliament. In 1316, after a long blockade, the town and castle surrendered to the Scottish forces under Edward Bruce; and in the month of April 1642, it was taken possession of by 4000 Scotch auxiliaries under the command of general Monroe, who retained possession, till he was surprised and made prisoner by general Monk in 1648. In the beginning of next year, general Monk was made prisoner by Lord Inchiquin; and, in the latter end of the same year, the town and castle surrendered to Sir Charles Coote. On the 12th August, 1689, Duke Schomberg arrived in the bay with ninety vessels, having about 10,000 troops on board, and disembarked the next day at Grooms Port near Bangor. On marching to Belfast, the enemy retired to Carrickfergus, where several regiments were instantly detached with cannon. The place was summoned in form; but not agreeing in the terms, batteries were raised. On the 22d, trenches were opened, and the siege carried on in form till the 26th, when several breaches being made, and all things ready for an assault, the garrison surrendered, obtaining leave to march to Newry, where the Duke of Berwick, natural son of James II., commanded. On the 14th of June 1690, King William landed here, attended by Prince George of Denmark, the Duke of Ormond, and many other noblemen of distinction. On the 21st February 1760, Commodore Thurat arrived in the bay with the following ships, Belleisle 44 guns, Le Bland 32, and Terpsichore 26; being part of a large fleet intended for the invasion of Ireland by the French. Thurat proceeded to land his men, which amounted to about 1000, at Kilraat, and instantly marched to attack the town of Carrickfergus, the garrison of which consisted of about 180 men of the 62d regiment, commanded by Colonel Jennings. The garrison made a vigorous resistance from the town wall and gardens, and afterwards retreated into the castle. The French then formed into three grand divisions, and attempted to force the castle gate, but were beat back with considerable loss. The garrison having now expended all their ammunition, Colonel Jennings was reluctantly obliged to surrender, and obtained honourable terms. During the heat of the engagement, "a French soldier observing a child who had run playfully into one of the streets amid the fire of the contending parties, grounded his musket, carried the infant to a place of safety, and, returning to his comrades, resumed the combat." Such a humane action deserves to be recorded, whilst we regret that the name of the generous individual is unknown.

The enemy's loss is supposed to have been about 40 killed, among whom were three officers, and between forty and fifty wounded, amongst whom was General Colbert, the commander in chief. The garrison had only two killed and three wounded. Thurat was desirous of landing at White-house, and surprising Belfast; but to this plan the general objected, fearing to be harassed by leaving a garrison in his rear. The French evacuated the town in great confusion on the 26th of the same month, and were captured on the 28th by Commodore Elliot off the Isle of Mann. Carrickfergus is situated about 9 miles North East of Belfast, and 89 from Dublin. West Long. 5° 48′, North Lat. 54° 36′. (c)

CARRIER, a species of pigeon, which has received that name from being employed in conveying letters from one place to another. It is the Columba *tabellaria* of Linnæus, and is thus characterised, " cere broad, carunculate, whitish, eyelids naked." But this description is too indefinite to enable ordinary observers to recognise the species; we may therefore remark, that the carrier is of a larger size than the greater part of pigeons, being 15 inches in length from the point of the bill to the extremity of the tail, and sometimes weighing 20 ounces. Its shape is more symmetrical from the length of neck and closeness of the feathers; and the breadth of the chest, added to these two, are considered not only indications of the use, but of the qualities of the individual. The colour is not a distinguishing mark, the carrier being black or dun, blue, and blue-pyebald, the two latter of which are most esteemed by pigeon fanciers from their rarity. The cere of this bird is very large, extending over half the upper chap of the bill in a white, tuberous, furfuraceous flesh, called the wattle, hanging down on both sides next the head, and terminating in a point about the middle of the bill. On the appearance of this several properties are supposed to depend, which has given birth to cruel operations on the bird. As the wattle of a good carrier should be broad across the bill, and rise high at the head, a method has been contrived to impose on the less skilful, by artificially elevating the hind part with cork fixed in by wire, in such a manner as scarcely to be perceptible. The eyes are surrounded by the same furfuraceous substance, extending to about the diameter of a shilling; and the wider it is, the more the carrier is valued. But the best birds are said to have three peculiarities in the appearance of the bill, three in the wattle, three in the head, and as many in the eye: though some concentrate them in one each, to which are added the length and slenderness of the neck, and the length of the body. We are unacquainted with the country of which the carrier is indigenous; but it is said to have been imported into Britain, where it is now completely naturalized, from Bussorah.

Though the superstitious partiality with which pigeons in general have been viewed, may perhaps be traced to passages in Scripture, the qualities of the carrier were prized before the Christian religion was known, and in countries where it was never recognised. It is the peculiar property of this bird to find its way through the air from incredible distances, over which it has been conveyed hoodwinked, or in a covered basket, back to its usual abode, which has taught mankind a mode of transmitting intelligence by its aid. The Greek and Arabic poets, in their figurative language, alike represent the interchange of amatory billets by pigeons; and Martial describes one as an ominous messenger of welcome tidings.

> Aera per tacitum delapsa sedentis in ipsos
> Fluxit Aretullæ blanda columba sinus.
>
> ... ...
>
> Hæc a Sardois, tibi forsitan exulis oris
> Fratre reversuro, nuncia venit avis.
>
> LIB. viii. ELEG. 32.

But we are distinctly told by Ælian, that Taurosthenes, a victor in the Olympic games, communicated his success to his father by means of a pigeon, to which a purple ligament was affixed. Pliny also narrates, that a correspondence was carried on by means of pigeons, at the siege of Modena. *Quin et internunciæ in magnis rebus fuere epistolas annexas earum pedibus obsidione Mutinensi in castra Consulum Decimo Bruto mittente.* " Of what avail," he adds, " were centinels, circumvallations, or nets obstructing the river, when intelligence could be conveyed by aërial messengers." More recent instances are given of the utility of pigeons, in communicating information to the besiegers or besieged during times of warfare. It is said, that while an army was besieging Tyre, in the Crusades, intelligence from a distant quarter was suspected, from a pigeon being frequently observed hovering over the city. By some means the besiegers obtained possession of the bird, removed a billet attached to it containing useful information, and replaced it with deceitful intelligence. The pigeon was again liberated; and having conveyed the false information, the besiegers were enabled to render themselves masters of the place. In other cases correspondence has been intercepted, where the bird, terrified by the sight of a hawk, has sought the earth, and thus fallen into the hands which it was most important to avoid.

In more modern times, the carrier has been employed to convey intelligence, which required immediate communication to the Turkish government, which practice subsisted in the time of Sir John Mandeville, who travelled in the 14th century, and is alluded to by Baumgarten, who was at Alexandria in 1507. At a later period, there was a regular chain of posts, kept up by high towers, between 30 and 40 miles asunder, provided with pigeons, and sentinels stood there, constantly on the watch, to secure the intelligence communicated to each, and transmit it along. The notice was inscribed on a thin slip of paper, enclosed in a gold box of small dimensions, and as thin as the paper itself, suspended to the neck of the bird: the hour of arrival and departure were marked at each successive tower, and, for greater security, a duplicate was always dispatched two hours after the first.

It was not uncommon, in the course of the 18th century, for the English merchants at Aleppo to obtain intelligence of the arrival of their vessels at Scanderoon by the same means. Whatever could be comprised in few words, was written on a slip of paper, and fastened to the pigeon, which immediately took flight. It was usual to send down the pigeons from Aleppo, that they might always be ready at the port, and no delay ensue. Maillet, the French consul in Egypt, relates, that a merchant of Aleppo, having accidentally killed one of these feathered messengers, was the first to learn that a scarcity of galls prevailed in England, and profiting by the intelligence, he made a speedy transaction, by which he gained 10,000 crowns. This practice of employing pigeons, in Syria, has been discontinued.

We are not aware that the carrier pigeon, and its kindred species, have been used in Britain for the regular conveyance of written intelligence. But some years ago there were instances, and perhaps not uncommon, of a pigeon being let fly at the moment of an execution at Tyburn, whereby the relatives of the unfortunate criminal might be warned of his fate. In the latest times, they have chiefly been converted to use, in announcing the issue of wagers between places far asunder; and considering the rapidity of their flight, certainly they are not unsuitable messengers. Nevertheless the carrier pigeon is not the only bird which the ingenuity of mankind has entrusted with being the bearer of information. The swallow has been thus employed, though not in a systematic manner; and the ancients relate that one of the kings of Egypt had a crow so well trained, and which had been so useful to him, that after its death he preserved it in a tomb.

The carrier is naturally endowed with the faculty of returning to its usual place of habitation; but certain precautions have been observed to render its mission more secure. It is only used during the time of incubation, or while it has unfledged young: besides, a kind of training is adopted, whereby lesser distances are passed over in its return, before the full flight is required. The Turks take a pigeon, on gaining its ultimate strength, and first carrying it half a mile in a basket, allow it to fly: it is next carried a whole mile, and so on, increasing the distance to twenty or thirty miles. The same was done between Aleppo and Scanderoon, and, at last, when judged to be sufficiently trained, those which had young were sent down to the port. When the pigeon was allowed to escape, its feet were bathed in vinegar, with the design of keeping them cool, and to restrain the bird from alighting in quest of water, by which the billet which was fastened under its wing might be injured, or the journey prolonged. But it was necessary that there should be no great interval after removal from its young, and if a fortnight elapsed, the return of the pigeon could not be relied upon.

Immediately on escaping, the carrier towers to an immense height, and then commences its progress with inconceivable rapidity. Though it be difficult to ascertain the velocity with which a bird cleaves the air, it has justly been assimilated to the flight of an arrow from the bow, and some have ventured to hazard conjectures on the subject. Mr Cartwright, who lived so long in a desolate region, computed the rate at which certain wild ducks flew, to be 90 miles an hour: the celebrated Spallanzani found by experiment, that a swallow flew from Bologna to Modena, which are 20 miles distant, in 13 minutes; and he affirms that the common swift can fly 60 miles in a quarter of an hour. We do not know that the carrier is endowed with such incredible speed; but Damiri, an Arabian author, maintains, that it can traverse a space equal to about 450 miles in a day. Maillet says that, when fairly in flight, it does not occupy above half an hour in ten leagues; and D'Arvieux, in calculating the distance between Scanderoon and Aleppo at 40 leagues, observes, that pigeons pass from the one to the other in three or four hours. However, when employed by the English factory of the latter place, they have been known to perform that flight in two hours and a half. A well authenticated experiment is described, where a pigeon being let fly from St Edmund's Bury in England, reached London in the same time, the distance being 72 miles. Most probably the rate of flight is not less than 30 miles an hour, and perhaps considerably more. See Bochart *Hierozoicon*, tom iii. col. 15, 16. Leyden, 1692. Ælian *Varia historia*, lib. ix. cap. 2. Plinii *Historia Naturalis*, lib. x. § 34. Maillet *Description de l'Egypte par Mascries*, part ii. p. 140 in 4to. Pennant's *British Zoology*, vol. ii. *Treatise on Domestic Pigeons*, p. 75. Russel's *Natural History of Aleppo*, vol. ii. p. 203, 429. (*c*)

CARRON Works, the name of an iron foundry in Scotland, on the most extensive scale, situated by the side of the river Carron, about three miles above its junction with the river Forth, and about two miles north from the town of Falkirk, in the county of Stirling and parish of Larbert.

These works were projected by the late celebrated and enterprising Dr John Roebuck, who, after visiting many situations in Scotland for the purpose of erecting an iron work and foundry, at last fixed upon the present site. They were established by a company, with Dr Roebuck at their head as the acting partner, in the year 1760.

The company are chartered, having an original capital of 150,000*l.* divided into six hundred shares of 250*l.* each, which are now in comparatively few hands. These shares sell at present at an advance of thirty per cent., and the company divide upon the purchase sum about seven per cent. each year, payable half yearly. Besides the above increased capital, there is a very great undivided and accumulating capital, consisting of landed, mineral, and heritable property, with an immense stock of all materials requisite for carrying on a concern so very extensive; for as a foundry, it is indeed the most extensive in the world, though, as to making of pig iron, it is on a small scale in comparison with several iron works in Great Britain.

One primary object in placing these works where they are, appears to have been that of having the full command of the river Carron, for driving the heavy machinery, requisite for an iron work, together with the facility of water carriage for the raw materials and manufactured articles.

As the river Carron flows but a short way through a champaign country, and as its source is not very distant, it is on that account suddenly swelled with heavy rains, and as suddenly reduced by a short continuance of drought. This circumstance rendered it absolutely necessary to collect the river Carron into a large reservoir immediately adjoining the works, though even this was found, from the intermitting of the river, quite insufficient for the purposes of the work. To correct this defect, a very powerful steam engine, upon the common construction, is employed to raise the water after having passed over the wheels, and is discharged into the reservoir again. This machine raises the water about 36 feet high, by means of four very large pumps, and is capable of lifting 40 tons of water each minute, which flows from it like a river, to be again used at the water wheels. From the great extension of the works, even this vast auxiliary power was found insufficient, and of late a very powerful steam engine for blowing, made by Messrs Watt and Bolton, has been erected, capable of blowing three blast furnaces. It has two regulating cylinders, which support, by the compressed air, floating pistons of no less than 15 tons weight each, which produce a regular uninterrupted blast.

The machinery driven by water is chiefly employed for blowing into the blast furnaces and cupolas, for the boring mills, forge hammers, plating mills, and polishing mills, also for grinding fire clay, and charcoal.

There are five blast furnaces, which produce nearly 200 tons of pig iron each week, in which coak, viz. mineral charcoal, only is used. Of air furnaces and cupolas there are above 20 capable of melting, for foundry purposes, double that quantity of metal. Here all kinds of ordnance are cast, such as mortars, cannons, and carronades, of every caliber, not only for the British government, but for all the European powers. They are all cast solid in a perpendicular direction, and are afterwards bored to the requisite caliber, with machinery moved by water. From long habit, and the constant attention paid to this department, the pieces of ordnance made here are of the best kind, and of the proper texture of metal, being greatly consolidated by a heavy pressure of liquid metal poured in a perpendicular direction. In former times all the ordnance made here were tried with the full powder proof before being sent from the works, but they are now only proved by water forced into the chamber by a very powerful compressing engine, a method of proof which is reckoned much better than the former. The carronade gun, so well known in the navy, invented in Ireland by General Melville, was perfected at Carron, (from which it derives its name,) by the joint aid of several scientific gentlemen. Mr Gascoigne, (afterwards Sir Charles Gascoigne,) the then manager, had an active hand in this improvement.

Immense quantities of shot and shells are also made here, besides every article in the foundry line, such as engine cylinders and materials, pipes, boilers, ovens, vats, pots, grates, machinery of all kinds, and in short articles of every description so universally known by the name of Carron goods. From the minute attention paid to the manufactory of all articles made here, they are in general so well executed, that the name *Carron*, upon cast iron goods, gives them a kind of sterling stamp.

Smith work, particularly all the varieties of the heavy kind, is also executed here on a great scale, and in the best manner.

All the various machinery employed at Carron, is plain, substantial, and well finished, without the least aim at finery; a principle of the first importance, and worthy of imitation in all such concerns.

From the great extent of this foundry, the fire blast furnaces cannot supply the consumpt of pig iron, so that it is estimated that the company buy annually a quantity of iron equal to the produce of other five furnaces; the consequence of which is, that they are constantly in the market for iron, both in Scotland and Wales. Only a small quantity of malleable iron is made for their own particular uses.

Upwards of 2000 people are employed at the works in the various departments, so that it may be estimated that at least 6000 souls depend upon the Carron company immediately for subsistence.

With respect to the raw materials used at the works, the coals are supplied by two large collieries adjoining the works, which are brought direct from the pit mouth to the furnaces, by means of improved cast-iron rail-ways. The main seam of coal is about four feet thick, partly of slate, and partly of cubical coal, being the only coal in these collieries hitherto wrought for making iron. A plan has been here adopted of working by means of sliding rods and pumps, under dip of the engine levels, to a greater extent than has been practised in any part of Scotland; a mode to which the company have paid great attention, and upon which they have very much improved. The sliding rods are moved by the engine above ground, and by this mode collieries have been revived by the same engine pit and machinery, which were considered as exhausted in the common mode of working. The consumpt of coals is no less than 200 tons each day; from which we may easily conceive not only the magnitude of the works, but also the great annual excavation of the coal fields by such an expenditure of fuel.

It is somewhat remarkable that none of the iron stone, used at the furnaces, is found in the immediate neighbourhood; the chief supply of it is brought from the westward down the great canal, which passes within a mile of the works, and from the coast of Fife: all of it is of the common argillaceous iron stone, yielding from 25 to 30 per cent. of iron: only a small quantity of the Cumberland rich iron ore is used in the furnaces occasionally, for giving the metal a peculiar texture. The lime-stone, used as a flux in the furnaces, is also brought from the coast of Fife. All the fire-bricks used for lining the furnaces are made at the works, from a clay which is found immediately under a thin coal in one of their collieries, and which resists well the action of fire.

As the quantity of ordnance stores, and the various articles made at this work, are immense, the company keep from 15 to 20 vessels in their employment, for carrying their manufactures to London, Liverpool, and other ports, and for bringing iron-stone and lime-stone to the works, the greater part of which vessels are their own property.

Till within these two years all the cartage for the works was done by single horse carts; but the improved rail-ways have superseded that mode. It is remarkable, that all the carts employed at this extensive iron work had wooden axles, which the carters preferred: the reason assigned for this was, that in the deep cut roads, the concussions were not so severe upon the horse as if they had been of iron.

This great work is under the direction of one manager, and the whole is conducted with the greatest order, attention, and economy, and no where in Scotland are the wages of workmen more moderate. Here societies are formed by the workmen, and patronized by the company, for the relief of those in distress, or who are superannuated—a system highly beneficial in all large works.

In a commercial view, these works are well situated, having an easy access by water to the river Forth on one hand, and to the river Clyde on the other. A canal is carried from the river Carron (below the works) within the area of the buildings, where the manufactures are easily put on board small craft, and carried down to the Carron wharf, and shipped in large vessels.

From the extensive scale upon which the works are carried on, the circulation of money is great and regular; so that this establishment has contributed greatly to the prosperity of the surrounding district, and it has not only been highly beneficial to the property in its vicinity, but also to the country and nation at large.

On approaching Carron, every stranger is struck with the very great stock of coals, iron-stone, and lime-stone, and with the various horrid instruments of war, scattered or piled up in every direction, while, at the same instant, the ear is assailed by various discordant sounds, such as the impetuous rushing of water, the creaking of boring mills, the varied clanking sound of ponderous hammers, with the loud and constant hissing of the blast furnaces, in the midst of which the eye is arrested by large fields of burning coals, producing a smoke which at times almost obscure the light of the sun, and which in the night, highly illuminate the atmosphere to the distance of many miles; while, in another direction, the metal is pouring in streams of liquid fire, throwing off starry coruscations of light. These various operations, with the numerous workmen going about in busy confusion, produce a "*tout ensemble*" quite unparalleled and astonishing. (R. B.)

CARROTS. See Agriculture, *Index*.

CARSTARES, William, an eminent Scotch clergyman and statesman, was born on the 11th of February 1649. From his father, who was minister of Cathcart, in the neighbourhood of Glasgow, he received the best education which the country could afford. He was placed under the care of Mr Sinclair, a Presbyterian clergyman at Ormiston, who kept a large and genteel academy. There he acquired that taste for literature by which he was afterwards so much distinguished, and formed those connections, which he continued to maintain, with some of the first men in the kingdom. From this academy he went to the University of Edinburgh, where he made great progress in the scholastic philosophy of the times, and ultimately applied, with a professional view, and with considerable success, to the study of theology. But his attention soon began to turn from divinity to politics. The situation of the country, and the complaints of the people, operating upon a mind naturally generous and ardent, determined him to co-operate with those who were seeking a redress of grievances, and to devote his services to the cause of civil and religious freedom. His father, apprehensive of his engaging too deeply in that opposition to the court measures which was then going on, sent him to the University of Utrecht, under the pretence of affording him the best opportunities of completing his studies. But this measure of precaution had an effect the very contrary of what it was intended to produce. Young Carstares got a letter of introduction from his father to a physician in London, who happened to be one of those who kept up a correspondence with Holland; and who, on finding that he was well acquainted with Scottish affairs, and might be of great service to the Prince of Orange, gave him a letter of recommendation to the prince's physician. Through this medium he was soon introduced to the Pensionary Fagel, and next to William himself, from whom he received every mark of confidence and favour, and with whom he now laid the foundation of that friendship which subsisted between them till death. After residing for some time at Utrecht, and attending no less to political business than to literary pursuits, he returned to his native country, at once possessed of all the secrets of the Dutch court, and confirmed in those principles of liberty which he had originally embraced. He obtained license to preach the gospel according to the Presbyterian form, to which, both from conviction and education, he was strongly attached. But seeing no prospect of being useful as a clergyman in Scotland, he resolved to go back to Holland, where he was sure to enjoy those privileges which were withheld from him at home. As he intended to go by London, he was employed by Argyle, and the other Scotch patriots, to treat with the English ecclesiastics; and accordingly he had several conferences with them, and engaged in negociations with the malcontents every where, for the purpose of securing an union of counsel and of efforts in the common cause. He engaged in the Rye-house plot, deeming it perfectly justifiable to take up arms for the assertion of those constitutional rights which had been violently invaded, and which remonstrances and complaints had failed to recover; but at the same time expressing the utmost abhorrence of the proposal which had been made to gain that object more effectually, by the assassination of the King and the Duke of York. On the discovery of this plot, he was apprehended and thrown into prison, where he remained for eleven weeks. At length he petitioned the Court of King's Bench for his Habeas Corpus, but, instead of obtaining it, he was, contrary to his own desire, and to the maxims of criminal justice, sent down to take his trial in Scotland. As soon as he arrived in Edinburgh, he was put into irons. For several weeks he continued in that painful situation, urged all the while most earnestly by one of the secretaries of state to divulge what he knew, and encouraged to do so by the promise of a pardon. This method not succeeding, he was subjected to the torture,—a mode of extracting evidence which still existed in all its vigour; but, though it was inflicted with great severity in presence of the privy council, he bore it with the utmost firmness, and persisted in maintaining an unbroken silence. At length, a milder and more insidious treatment was resorted to, which had the effect of subduing, in some measure, the stubbornness of his virtue. On condition of his answering certain questions that were put to him, he was not only assured of receiving a pardon for himself, but also of never being produced as a witness, or having any of his statements brought forward as evidence, in the trial of any other person. He stipulated, besides, that these engagements should be confirmed by a regular deed of court, and distinctly recorded in their books. This agreement, however, was shamefully violated by the government, who printed what they called Mr Carstares's confession, containing a very imperfect and false account of the transaction, and basely employed it to procure the conviction and condemnation of Mr Baillie of Jerviswood, one of his most intimate friends. This circumstance affected him deeply, and had nearly overwhelmed his spirit. During his confinement in the castle, where nobody had access to him but his enemies, and where he had to struggle with the infirmities of a shattered constitution, as well as with the peculiar evils of his situation, he endeavoured to relieve the irksomeness of his captivity by the frequent perusal of Thuanus the historian, a copy of which he had fortunately procured, and which he carefully read over no less than three times.

After being released from imprisonment, he was permitted to retire to Holland, where he arrived about the beginning of the year 1685, and was soon appointed chaplain to the Prince of Orange, and minister of the English Protestant congregation at Leyden. He was now more than ever both able and willing to serve the Prince. Accordingly, he was much with him, informed him accurately of the state of affairs in Britain, gave him complete insight into the temper and character of the principal men by whom public affairs were conducted in that country, made him acquainted with the dispositions and views of such of the British mal-contents as resorted to Holland, and at last accompanied him, in the capacity of domestic chaplain, in his ever memorable expedition to England in 1688. At the revolution which then took place, he was always consulted by William, and gave his advice with so much frankness, and at the same time with so much wisdom, that he continued to possess the confidence of William, who, though he appointed him his chaplain for Scotland, and annexed to that office the whole revenue belonging to the Chapel Royal, yet signified to him that he required his constant attendance upon his person, assigned him apartments in the palace when in England, and, when abroad, allowed him 500*l*. every campaign, for camp equipage. Mr Carstares was instrumental in procuring a loyal address to his master from the Presbyterian clergy of Scotland, which was very acceptable to the Prince. On the other hand, he was instrumental in procuring for his native country the establishment of that form of church government, to which he himself and the great body of the people were so partial; and this object was not attained without some difficulty, as the King was anxious that the same ecclesiastical regime should prevail in both parts of the island. But he agreed with his Majesty in disapproving of the act which was passed for abolishing the right of patronage, because he feared that it might lead to dangerous consequences, and be attended with an abuse of that power which it lodged in the hands of the people. He also gave an advice to William, which shewed that his zeal for royal authority was beginning to encroach upon his attachment to public liberty. His advice was this, that the King should be extremely cautious in giving up any branch of his prerogative,—a danger to which, as he alleged, William was the more exposed, because he had been raised to the throne by the voice of the people. In 1693, an act was passed in the Scottish parliament, obliging all persons in office not only to take the oath of allegiance to the King and Queen, but also to subscribe an assurance, declaring that William was king *de jure*, as well as *de facto*. The Presbyterian clergy refused to sign the declaration, and applied to the privy council for redress; but they thought proper to withhold the indulgence, and, under sanction of the King's authority, which they procured when Mr Carstares happened to be absent from court, either to require every representative to the General Assembly to obtemper the act, or, in case of disobedience, to dissolve the assembly in his Majesty's name. The clergy sent up a memorial on the subject to Mr Carstares, who immediately waited on the King, though at a late hour,—awaked him out of his sleep,—represented to him the unjust nature and dangerous tendency of that measure which his government in Scotland had adopted,—and prevailed upon him to countermand the order that had been given, and to dispense with the oath to which the ministers objected. This act of William's administration had the effect of making him very popular in Scotland, and restored Mr Carstares to the good opinion of his countrymen, who had, on several accounts, begun to suspect the sincerity or the ardour of his attachment to their cause.

Mr Carstares continued to have the chief direction of Scottish affairs; and he conducted himself with such ability, prudence, and uprightness, that William's confidence in him increased with the duration of his services, notwithstanding the many attempts that were made by his political enemies to lower or supplant him in that monarch's estimation. He had a difficult part to act; but the difficulties of his situation were not too much for his wisdom and vigour to surmount. He equally checked the hostility of his foes, and secured the affection of his friends; and was so impartial and disinterested, that though he could only gratify the views of some, he commanded the respect of all. At the death of William, which could not fail to afflict him most sensibly, he was just as poor as when he first entered into that prince's service,—a circumstance highly creditable to him, since he had such fair and excellent opportunities of securing for himself an independent fortune.

In the succeeding reign, Mr Carstares's connection with public business was but limited, though he was of too much consequence to be entirely overlooked. Queen Anne, unsolicited, appointed him her chaplain for Scotland. He was also made principal and primarius professor in divinity of the university of Edinburgh; and, in the same year, became one of the ministers of that city. The duties of his pastoral office he discharged with equal ability and success; and though he had been long out of the habit of preaching, his discourses were very much and generally admired. His close attention to politics did not seem to have injured his literary attainments; for we are told that his first oration after his introduction into the university, which was delivered before a numerous and respectable audience, exhibited so much profound erudition, so much acquaintance with classical learning, and such an accurate knowledge of the Latin tongue, that his hearers were delighted: and the celebrated Dr Pitcairn declared, that when Mr Carstares began his address, he could not help fancying himself in the forum of ancient Rome. As Principal of the university, he was very attentive to its interests and prosperity. The salaries of the professors being extremely small, he procured an augmentation to them out of the bishops' rents, in consequence of an application to the Queen and her ministers, with whom his influence was still very considerable. The same boon was, through his means, extended to all the other universities of Scotland; and, to shew the generous spirit by which he was actuated on this occasion, he refused to appropriate any part of the gift which had been obtained, to the increase of his own professional emoluments.

The first General Assembly which met after Mr Carstares became a minister of the church, chose him for their moderator; and this honour he enjoyed no less than four several times in the course of eleven years,—a fact which shews clearly the acknowledged superiority of his talents, and the great extent of his influence. This influence, indeed, enabled him to preserve his interest with the court, because it enabled him to secure the acquiescence of the clergy when it was of real importance to possess it, and when it could not otherwise have been obtained. One striking instance of this occurred in the case of the union, which could not have been accomplished if the clergy had opposed it, and against which they were actually disposed and prepared to remonstrate. Mr Carstares prevented them from carrying their design into effect; and for this eminent service the Queen took the opportunity of his being in London in the year following, to thank him in person, and at the same time to bestow upon him one of those few silver medals in commemoration of the union, which she had ordered to be struck off for her particular friends.

Though the union took away from the church of Scotland much of that importance which it had hitherto possessed in the eye of administration, and though, since it was no longer formidable to them, they no longer felt any great deference for its claims, yet Mr Carstares, by his personal exertions, contrived to uphold its respectability, and to preserve to it some portion of weight in the government of the country. His views, however, were much obstructed by the violent spirit and intemperate conduct of many of his Presbyterian brethren; and he had the double and painful task of first exposing himself to their censure by resisting their prejudices, and then of vindicating to the Queen and her ministers those very proceedings which he had formally condemned before they were adopted. When the bills for the restoration of patronage, and the toleration of the Episcopal clergy in Scotland, were brought into Parliament, he was one of the representatives sent up to oppose them. The opposition, which he seems to have carried on with sincerity, was unsuccessful. It was fortunate, however, that he had gone to London on this occasion, as it afforded him an opportunity of preventing measures which went directly to the material injury, if not the complete destruction, of our Presbyterian church. It was actually proposed, by some members of administration, to discontinue the annual meetings of Assembly, or, if they should be convened, to prorogue them as soon as they were constituted: and it was even in contemplation to bring a bill into Parliament for the purpose of taking away the only pretext of holding them in future. Mr Carstares prevailed on the government to refrain from these unjust and oppressive measures, on condition of his undertaking to use all his endeavours to allay those ferments which the late acts of the legislature had excited. In these endeavours he succeeded so well, that the Queen and her ministers were perfectly satisfied; and so high did he stand in their regard, in consequence of his prudent management, that they required him to name the person who should be appointed commissioner, and to dictate those instructions which he should think seasonable in the existing circumstances of the country.

Mr Carstares was extremely zealous for the Protestant succession in the House of Hanover; and said and did every thing in his power to forward that object. Of so much importance were his services deemed, that George I., two years before his arrival in England, signified, by a letter from his secretary, his acknowledgments to Mr Carstares for the part he had acted, and continued him his chaplain for Scotland; an office, however, which he did not live long to enjoy. In the month of August 1715, he was seized with an apoplectic fit, which carried him off about the end of December following, in the 67th year of his age. His body was interred in the Greyfriar's church-yard, Edinburgh, where a monument was afterwards erected to his memory, with a suitable inscription in Latin. By the university, the church, and the country at large, his death was sincerely lamented. They had good reason; for he had been to all of them a useful servant, and a distinguished ornament. King William declared, in presence of several of his courtiers, "that he had known Mr Carstares long; that he knew him well; and knew him to be an honest man." See M'Cormick's *Life of Carstares, prefixed to Carstares' State Papers.* (τ)

CART. See AGRICULTURE, chap. vi. sect. iv.

CARTES. See DESCARTES.

CARTESIAN TEMPERAMENTS OF THE MUSICAL SCALE. That the versatile genius of M. Descartes early led him to the consideration of the musical scale, is well known; but that his speculations on this subject proved not less abortive and inapplicable to the art, than his vortices and other parts of his philosophy were to the phenomena of Nature, has not, we believe, been any where shewn.

According to the "Animadversions" of Lord Brouncker "on the Musical Compendium" of Descartes, it appears, that two different systems of musical intervals, but constructed on similar principles, were recommended by that author to the adoption of musicians, viz. one wherein a ratio, whose common logarithm is .9754132, (a *semitone*, the smaller of Descartes, or interval $= 49.97718\Sigma + f + 5m$,) is 10 times added to itself, leaving a difference, or wolf, flat, or in defect, on the twelfth or resulting semitone, of about $\frac{111}{100}$ of a major comma, or more exactly of -12.2186Σ; the other, wherein the log. .9744813 (or the larger *semitone* of Descartes, $= 51.87864\Sigma + f + 5m$) is 11 times repeated, leaving a semitonic wolf about $\frac{96}{100}$ of a major comma, or more exactly $+ 10.5985\Sigma$, sharper than the other semitones of this system.

These systems have been supposed by some persons to approach very nearly to the equal temperament, or *isotonic* system, which is, however, far from being the case; and they appear so very inapplicable to practice, that we shall dispense with calculating the *beats* of the 12 several fifths in each of these systems, according to our usual practice, and rather devote the room they would occupy, in explaining some of the most material properties of all systems constructed on similar principles to the above, viz. wherein *eleven semitones are equal:* In which case, the most favourable situation for the resulting semitone or wolf seems to be between G♯ and A, and yet here it will be found, that only the five keys C, B♭, A, B, and C♯, can have their Vths, IIIrds, and 3rds, unaffected by this semitonic wolf; that D, E♭, and E, are the only remaining keys that can have their IIIrds and 3rds so unaffected; and that F, with a 3rd unaffected, is the only remaining key that can have either of its concords uncontaminated by the semitonic wolf of such a system. And it must not be imagined, that the above are the anomalous keys; and that those which include the resulting semitone, may be made, by a proper apportionment of the wolf, more harmonious than the above keys that exclude it, since it will be found on trial that G, F♯, and G♯, are the only three keys that can have the advantage of a semitonic wolf so contrived, in their Vths, IIIrds, and 3rds, in each case; and that F is the only remaining key where the Vth and IIIrd can be taken to include the semitonic wolf, situated as above. And thus it appears, that in these Cartesian systems, on one of the above suppositions, no key bearing *one* sharp or *one* flat in its signature, and many others not much less frequent in use, can be made tolerable; while, on the only other supposition that can be made, (as to the value of the semitonic wolf as affecting the concords, the fifth in particular,) the natural keys (C and A) with most others in frequent use, must be sacrificed to others less frequent in their occurrence: disadvantages which do not attend the more rational system of *eleven equal fifths*, instead of semitones, as shewn by Mr Farey, in his account of *regular Douzeave Systems*, in the *Phil. Mag.* vol. xxxvi. p. 40. But we shall proceed to give a few theorems relating to Cartesian systems: Putting w for the *semitonic wolf*, or difference between the resulting semitone and all the eleven others, and r for the temperament or imperfection of the fifth resulting therefrom, though not included therein, and in terms of the small interval schisma or Σ, (see Plate XXX. in Vol. II.) First, $w = \frac{12}{7}r - 1.715409\Sigma$, whence the semitone may readily be calculated if the fifth be given: and it appears also, that when r vanishes, or the fifth is to be perfect, the resulting semitone is 1.715409Σ less than the other semitone. Second, $r = 1.0006552\Sigma + \frac{7}{12}w$: whence, having the semitonic wolf, or semitones themselves, (because VIII—12 semitones $= w$,) the temperament of the fifths may be had: and also it appears, that when w vanishes, 1.0006552Σ results as the isotonic fifth temperament, (see *Phil. Mag.* vol. xxxviii. p. 136.) Third, $V - r$ being the value of each of the 5 fifths, where w does not enter, $V + \frac{5}{7}r - 1.715409\Sigma$ will be the value of each of the 7 quint wolves or fifths, (or D, E♭, E, F, F♯, G, and G♯ in the above case,) wherein the semitonic wolf enters, as will be evident by equating these two classes of fifths, when $-r=-1.0006552\Sigma$ will result, as above. Fourth, We have $7.577045\Sigma-\frac{4}{7}r$ for the sharp temperament of the 8 major thirds, where *w* does not enter. Fifth, $5.861636\Sigma+\frac{7}{8}r$ will be the value of the 4 major tierce wolves (or F, F♯, G, and G♯,) wherein the semitonic wolf enters, which may be proved as above. Sixth, $7.577045\Sigma+\frac{3}{7}r$ is the flat temperaments of the 9 minor thirds, where *w* does not enter: And, Seventh, $9.292454\Sigma-\frac{9}{7}r$ will be the value of the 3 minor tierce wolves, (or F♯, G, G♯,) wherein the semitonic wolf enters; the equating of which last temperament and wolf, will prove *r* in them to be equal to the isotonic temperament in such case, as before.

The above temperaments and wolves of the principal concords in the four last theorems, are very differently related to each other from what they are in regular douzeaves, as will appear on comparing them with the 13th, 16th, 14th, and 17th of Mr Farey's *Corollaries*, in vol. xxxvi. p. 374, 375, of the Magazine above quoted.

On the whole it appears that semitonic systems of this kind, by having six more quint wolves than are necessary, and some of them falling in the most material keys, as G, F, D, &c. are unworthy of further attention, except as an exercise for the musical student, when enquiring into the very curious nature and constitution of the Scale, which they can never too much explore, and which the seven theorems that we have calculated and given above will be found greatly to facilitate. See our article TEMPERAMENT. (ϱ)

CARTHAGE.

CARTHAGE, the chief city of Africa Propria,[*] situated in longitude 10° 40′ east, latitude 36° 40′ north. The materials we possess for composing a history of the Carthaginians, bear no proportion to the importance of the subject. Every page of ancient history contains some reference to this remarkable people, some circumstance with which they were directly or indirectly concerned; yet are we almost wholly ignorant of their internal polity, and of all the secret springs which gave energy to their exertions. We find them bearing a part in the most important transactions of the civilized states, pushing their maritime discoveries and their system of colonization into the remotest regions, and at last striving with Rome herself for the mastery of the world: Yet of their resources we know scarcely any thing, except from analogy and conjecture; and of the events of their domestic history our accounts are meagre and unsatisfactory. The information we possess is for the most part derived from the casual notices of the Greek and Roman historians, few of whom had the opportunity, some, as it appears, not even the inclination, to give fidelity and accuracy to their narratives. It is our business, therefore, to put together the fragments which (without a metaphor) lie scattered throughout the ancient historians: from these something like a continuous narrative may be formed; though still we must content ourselves with a partial and imperfect knowledge of many important points.

According to Procopius, (*De Bello Vand.* lib. ii. c. 10.) the whole district of Africa, from Egypt to the Pillars of Hercules, was first peopled by the tribes that fled before Joshua from the countries of Canaan;—and it seems unquestionable, that the system of colonization which had been begun by the great Phœnician cities, received a very powerful impulse from the revolution which that conquest produced: an impulse which was felt, not only on the northern shore of Africa, but throughout all the countries of Europe. It is impossible to reconcile the various and contradictory accounts of the foundation of Carthage in any way, but by supposing, that they may have reference to the different stages of settlements made on that part of the African coast; and this supposition is strengthened by the authority of Sallust, (*De Bell. Jug.* c. 18.) Petavius has bestowed great pains on this most difficult point of chronology. He enumerates (lib. ix. cap. 62.) all the statements which he had been able to discover. The opinion he adopts is, that it was founded about the middle of the ninth century before Christ. This nearly falls in with Sir Isaac Newton's conclusion; and Blair, whose Tables we follow throughout, coincides with it, placing the building of Carthage, *ante Christ*, 869. We are perhaps justified in assuming this date as sufficiently exact, since it tallies very closely with the period at which the Phœnicians began to obtain naval ascendancy in the Mediterranean. The dominion of the seas had been obtained by the Lydians, the Thracians, the Rhodians, the Phrygians, and the Cyprians; the people of Phœnicia had now, in their turn, succeeded to it, and they maintained it in undisputed possession for upwards of 200 years. To this period we may, without hesitation, refer the adventures of Elissa or Dido;[†] who, as Justin informs us, quitted Tyre at the head of a numerous colony, to avoid the oppression of her brother Pygmalion. After touching at Cyprus, where she obtained an addition to her numbers, she proceeded to the African coast. A Phœnician settlement had been previously established at Utica, by which they were gladly received; the natives, too, welcomed their arrival, being eager to avail themselves of the commercial advantages which the arrival of the strangers held out. A negociation was speedily entered upon for an alotment of land;—the artifice which Dido is said to have practised in obtaining the alotment is well known: She covenanted for as much land as the hide of an ox would inclose, (*quantum loci bovis tergo circumdare potuerint;*) then, cutting the hide into shreds, she claimed as much as she could surround with them. The site of the infant colony was well chosen. A bold projection of the African coast marks almost exactly the central point of the southern shore of the Mediterranean. A noble bay, formed by the promontaries of Juno and Apollo, supplies all the advantages of a sheltered and capacious roadstead. At the bottom of this bay stretches a peninsula, 360 stadia, or about 45 miles, in circumference, connected with the mainland by an isthmus of the breadth of little more than three miles, (25 stadia.) Upon this istmus Dido laid the foundation of her new town.

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[*] There are some slight differences amongst the ancient geographers respecting the extent of the country which was called Africa Propria. Mela (lib. i. c. 7.) describes it as containing all the countries situated between the river Ampsaga and the borders of Cyrenaica: But this would include part of Numidia and Regio Syrtica, which must be considered as distinct from the proper territory of Carthage. Its true limits seem to have been, the river Tusca on the west, the frontier of the Garamantes and the deserts of Libya Interior on the south, and the Mediterranean with the Lesser Syrtis to the north and east. It was divided into two provinces, Regio Zeugitana to the west, and Byzacium or Emporia to the east.

[†] The name Dido appears to have been only a characteristic appellative, signifying, according to Servius, a 'virago,' but Bochart shews, that it meant a 'wanderer.'

It may not, perhaps, be unseasonable to give by anticipation, in this place, a description of the town, as it existed at the period of its greatest splendour. Several writers have left us minute accounts of its situation and appearance at the beginning of the second Punic war; by comparing and contrasting these accounts, we may be enabled to form some idea of its extent and magnificence.

The city consisted of three parts: Byrsa, or the Citadel; Megara, or Magaria; and the Cothon, or port. The quarter called Byrsa is said to have been twenty-two stadia in circumference, and was situated in the centre of the city: its highest point was a steep rock, on which stood a temple of Æsculapius. This part of the town was thought to have been built by Dido herself: its name is a Greek corruption of the true Punic or Phœnician word Bosra, or Bostra, *i. e.* a fortress or citadel. The name of the second division of the town, Megara, or Magaria, may also, according to Bochart, be traced to the Phœnician, in which language it signifies houses, or a town. It was situated so as to encircle the Byrsa. The name of the third quarter, Cothon, has also been derived from the Phœnician word which expresses an "artificial harbour." The entrance to the port was seventy feet broad, and was contrived so that it might be shut up with chains. The harbour was double; the outer part appropriated exclusively to the use of merchants, the inner fitted for the reception of ships of war. In the midst of the inner harbour was an island, which, as well as the harbour itself, was lined with large quays, in which were distinct receptacles (*νεωρια*) for laying up 220 ships of war: over these was a range of store-houses, for the necessary articles of naval equipment. The entrance into each of these docks was adorned with pillars of the Ionic order, so that the harbour and the island had the appearance of a magnificent gallery (*εις εικονα στοας.*) The merchants' harbour was completely separated from the arsenal, and had a distinct communication with the town, (Appian, *de Bell. Punic.*) As to the extent of the city, Livy intimates, (lib. li. *in epitom.*) that it was twenty-three miles in circumference;—the number of inhabitants was roundly estimated at 700,000. This is the number given by Strabo, (lib. xvii.); and if we consider, that Carthage united "extensive commerce and middling empire," the circumstances which Hume expressly mentions, (Essay xi.) as the obvious causes of the growth of large cities, it may perhaps be thought, that this statement is not so much overcharged as some of those which have come down to us, of the populousness of ancient nations.

At no period of their history did the Carthaginians lose sight of their Canaanitish origin. Plautus (*in Poenulo*, act. 5. sc. 3.) expressly alludes to it; and St Augustin says, that the tradition was even in his days preserved. Their language appears to have been formed by a mixture of Hebrew or Phœnician with the peculiar dialect used by the more ancient inhabitants of Africa. Hence the epithets in Plautus of *migdilybs* and *bisulcilingua*, (*Poen.* act. v. sc. ii.) But some authors have imagined, that the Libo-Phœnicians were a people distinct both from the Carthaginians and Libyans, in the same way as the mixed race bordering on the respective frontiers of Syria and Phœnicia were called Syro-Phœnician.

The government of Carthage was, at its origin, probably monarchical. Justin expressly assigns the regal character to Dido, (lib. xviii. c. 7.) A very short time, however, could have elapsed before it was changed into a republic: Its exact form cannot be ascertained. Aristotle, in a minute but somewhat obscure account, describes it as a mixed government, (*De Repub.* lib. ii. c. 11.) consisting of an aristocracy, and of what he calls *politeia;* by which word, as he himself explains it, (*Eth Nicom.* lib. viii. c. 12.) he means an oligarchy,—a government in which wealth formed the only title to office.* Polybius says, that the monarchical, the aristocratical, and the democratical forms were all united in it. But Isocrates (*Isocrates in Nicocl.* vol. i. p. 96.) seems to have had a more practical view of it, when he says, that the civil government was oligarchical, and the military monarchical; that is, in modern language, the legislative an oligarchy, and the executive a monarchy. For though the appointment and the functions of the Suffetes give to the constitution something of a monarchical air, the principle of the whole was oligarchical; all offices were elective, and all elections had reference to property. We will proceed to give some account of the constitution in its three branches.

The chief magistrates, two in number, called Suffetes,† were elected annually from the noblest families, and always supposed to be chosen for their wealth and talents. Their province was to assemble the senate, (*Liv.* 34. 62.) in which they presided, in order to propose the subjects of deliberation, and to receive the suffrages. If the suffetes concurred with the senate, the decision was final; if otherwise, the matter was referred to the people, (*Arist.* ubi supra.) It will be evident, that the suffetes answered in some degree to the kings of Lacedæmon, and to the consuls of Rome; consequently, in some authors, we find them indifferently called either kings or consuls, (*Justin*, xxxi. 3.) But they differ from the former, in as much as they were elective: and from the latter, as they were confined to civil affairs. It is not ascertained by whom the suffetes were elected, probably by the people, as an office similar to theirs existed in all the towns of note throughout the Carthaginian dominions.

The senatorial dignity was elective, as appears from Aristotle, but it is not known in whom the election lay. There does not appear to have been any specific qualification, as birth, riches, and individual merit are, in their turns, mentioned as supplying sufficient claims. We are ignorant of the number which composed the senate, though probably it was very large; for Justin mentions, (lib. xix. c. 2.) that on one occasion a hundred were selected to investigate some alleged misconduct of their generals. In this great council, every thing relating to peace and war, negociations and alliances, in a word, all affairs of consequence, whether foreign or domestic, were debated, and for the most part determined. There was, however, in its constitution one provision, which is obviously anomalous to every principle of good government. The decision of the senate was not final, unless the vote were unanimous, and received the sanction of the suffetes. Hence the people, by degrees, acquired an overpowering influence. The consequences were, as might be expected, fatal: For, during the second and third Punic wars, every thing was referred to the populace; while in Rome, on the contrary, the senatorial influence was in full vigour; and thus, as Polybius remarks, (book vi.) the Romans, even after their severe defeats, by means of their good government, *τῳ βȣλευεσθαι καλως*, recovered, and were finally victorious.

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* The authors of *The Universal History* observe, that in the *αριστοκρατια* men were supposed to be divided into the rich, the poor, and the virtuous; in the *πολιτεια* only into rich and poor

† This name is evidently borrowed from the Hebrew שפטים, *sophetim,* the appellation of the judges of Israel.

The centumvirate consisted of an hundred and four persons, elected from the senate; they seem to have had extensive power, though confined, as Aristotle (*ubi sup.* see also *Alexander ab Alexandro*, lib. iv. c. 11.) intimates, chiefly to affairs of a judicial nature. They were, as we have seen above, (*Justin*,) appointed, in the first instance, for the purpose of inquiring into the conduct of their generals in an unsuccessful expedition; and though their power afterwards was considerably enlarged, this seems to have been their principal business. Aristotle compares them to the Ephori at Sparta; but it will appear, that the tribunal which we shall next consider has a better title to this comparison. The quinquevirate consisted of five men, selected from the centumvirate, possessed almost of despotic authority. Their privileges are imperfectly known, but they seem to have been almost unlimited. They had cognizance of all affairs, whether of a public or of a private nature, and appear to have constituted a court of appeal in the last resort for all causes. It is not certain whether the office was perpetual. They not only had the power of filling up the vacancies in their own body; but we learn from Aristotle, that they chose those persons who composed the tribunal of the centumvirate.

The principal offices in the executive government of Carthage were, the prætor, the quæstor, and the censor; titles which seem to have been given by the Roman historians, from the analogy of their duties to the same officers in their own constitution.[*]

Of the system of Carthaginian legislation very inconsiderable traces remain; and those are important only as they throw light on the manners of the people.—Diodorus mentions a law of a very long duration, that those children alone who were nobly born should be sacrificed to Saturn. This had fallen into disuse, but was revived on an occasion of great public emergency, (*Diodorus*, lib. xx.) when two hundred children of the best families were offered at once to atone for the neglect. Some other laws regulating the popular superstitions are preserved. Indeed it is most singular, that of the very few fragments that remain to us, there is not one but is calculated, in some degree, to confirm the belief that Carthage must have been immersed in the most degrading barbarism. Even so late as the time of the elder Dionysius, we find that a law was made, (*Justin*, book xx. c. 5.) prohibiting every inhabitant of Carthage from learning either to write or to speak Greek. However, this absurd law must have been in a very short time either repealed or neglected, as Hannibal seems to have been eminently skilled in that language.

Accounts are preserved of several very peculiar customs which prevailed among the Carthaginians. In any great public calamity, the city was hung with black; this took place more than once. Its inhabitants fed on the flesh of dogs till the time of Darius Hystaspes, who interfered to prevent the continuance of this practice, and stipulated that their compliance in this point should be a condition of his entering into alliance with them; as also, that they should cease to offer human sacrifices, and that they should burn instead of burying their dead. The magistrates in office, and the soldiers in the field, were forbidden to drink wine. The generals were held personally responsible for the success of their undertakings, and several instances are recorded in which they were punished for their failure with death. The populace and senators had distinct baths; this is mentioned by Valerius Maximus (lib. ix. c. 5.) in proof of the extreme arrogancy of the senate; but he gives no further particulars relating to it. Like the Greeks and Romans, they had no public inns, but strangers were entertained in private houses; and, like them, they paid uniform respect to soothsayers of all descriptions.

It would appear that the religious worship of the Carthaginians was taken entirely from the Phœnicians; but as their frequent intercourse with the Greeks, especially those of Sicily, induced them to adopt many of their religious ceremonies, and even some of their deities, and, as the Greek and Roman writers invariably apply the names of their own deities to the gods of foreign nations, the subject is involved in very great obscurity.

The principal deity worshipped at Carthage, as Diodorus informs us, was Chronius, who, according to Quintus Curtius, (lib. iv. c. 3.) was the same with Saturn. Though the Punic name of this deity is not known, there seems good reason to conclude, from the similarity of rites, and other circumstances, that he was the same as Moloch, or Milchom, the famous idol of the Ammonites, Canaanites, and other neighbouring nations. (Levit. xviii. 21. xx. 2, 3, 4.)

The deity next in estimation was Urania, called, in the Phœnician, Bellis, or Belthes. It is not easy to determine whether she most resembled the Venus or the Juno of the Greek mythology. St Austin seems to have considered her as the first, but Virgil distinctly asserts that she was the second. (See *Æn.* i. and Heyné *not. in loc.*) Of the subordinate deities little is known, and that little is unsatisfactory. The most celebrated was the Tyrian Hercules, whose worship extended over the coasts of Africa as far as Cadiz, where he had a temple:[†] he was supposed to preside over gold and silver, and all sorts of treasures. Æsculapius, also, was a very popular deity, and had a temple on the summit of the Byrsa. A list of several other names is given, but little is known concerning them; some are supposed to have been celebrated persons, to whom divine honours were paid. In the preamble to a treaty made with Philip of Macedon, (*Polyb.* lib. vii.) there is an enumeration of many deities;

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[*] Aristotle argues, that the different powers in the Carthaginian constitution must have been very nicely adjusted, and states, in proof, its very long continuance, without a deviation into tyranny on the one side, or anarchy on the other: however, he himself notices, that the propensity for colonization, which seems always to have existed amongst the Carthaginians, may, in a great degree, account for this, though it cannot be considered as a remedy applied and enforced by the laws. With his characteristic acuteness, he detects the fault of the Carthaginian constitution, and foretells its baneful effects; remarking that the legislature is compelled to regard property rather than merit; *ȣ μονον αριστινδην, αλλα και πλȣτινδην ἁιρεισθαι τους αρχοντας.*

[†] For an account of this deity, and his name, Melcartes, see Newton's *Chronology*, p. 110, 111.

among the rest the *Δαιμων*, or genius of Carthage. We cannot determine who is meant by this title: it is sufficient only to notice the fact, and to add, that the heathen world looked upon these dæmons as intelligences of a middle nature between gods and men, as beings to whom the administration of the affairs of the world was committed.

Originally, the Carthaginian language was the same as the Phœnician or Hebrew; and notwithstanding some little variations, caused by the distance from the mother country, and the incorporation with the neighbouring nations, it ever continued in substance the same. An attempt has been made in modern times, to trace in the Maltese dialect the remains of the ancient Punic, and with some appearance of probability. As to the visions of the antiquarians of our own day, they are much too fanciful, and founded on much too narrow a basis, to detain us with a consideration of them.

Literature and science appear, during every period of their history, to have been at a very low ebb among the Carthaginians. Even the names of their writers have perished with their works.* However, it should be remembered, that the Romans exercised the most severe cruelty, in destroying not only the public archives, but almost every thing which the Punic writers had produced, which bore any appearance of general literature or history. But though this is sufficient to account for the total disappearance of the works of Carthaginian writers, we are not authorised to conclude, on the other hand, that they ever were very numerous, or very celebrated. In fact, it does not appear that the Carthaginians at any time were a refined or a literary people. In the first ages of their history, their character is stained by traits of the grossest barbarism; and this was afterwards modified, rather than subdued, by commerce and its attendant luxury. Plutarch represents them as uniformly of a morose and saturnine disposition, utterly averse to any thing which had the appearance of wit, raillery, or refinement. They seem to have been deeply tinctured with all the worst vices of a trading nation. They were tyrannical and cruel; sordid, and proverbially faithless; and though we must be inclined to receive with caution the accounts which their implacable enemies, the Romans, have left us, yet the whole tenor of their history is so uniform in this representation of them, that we are compelled to believe it, or to suppose the historians guilty of incredible malice, united with the most successful ingenuity. In turning to the brighter parts of their character, we are first attracted by their acknowledged skill in the mechanical arts. This, in all probability, they derived from their Tyrian ancestors; and we require no farther proof of their very great excellence, than the fact that, even at Rome, any singular invention, or curious piece of workmanship, was called, by way of eminence, Punic. Thus we find Valerius Maximus (lib. vii. c. 5.) speaking of the *Lectuli Punicani*, Plautus of the *Laternæ Punicæ*, and Cato (*de Re Rustica*) applies the epithet to a great number of things.

Their army was composed entirely of mercenaries. Polybius (lib. i.) gives a most sensible and eloquent enumeration of the evils of this system; and the acute historian of the Roman republic remarks, "That the Carthaginians were among the few nations of the world, who had the ingenuity, or rather the misfortune, to make war without becoming military; and who could be successful abroad, while they were liable to become a prey to the meanest invader at home." Hannibal stands almost a solitary example of a Carthaginian possessing superior knowledge in military science; only a short time before, his countrymen had been compelled to have recourse to the Grecian skill and discipline.

Their marine was most deservedly celebrated. Polybius (lib. vi.) does not hesitate to prefer it to that of any other nation in the world. The extreme attention which was paid to it, may be inferred from the description of the naval arsenal which we have given above. There are no means of ascertaining exactly the number of ships at any time actually fit for service; probably the Cothon was capable of receiving their whole navy.

In commerce and navigation they were, beyond all question, unrivalled. Their mariners were perfectly acquainted with all the ports of the Mediterranean. To the East their discoveries were extended as far as any other nation, and to the West they seem to have penetrated farther than their rivals presumed to follow them. In addition to their own export of staple manufactures, utensils, naval stores, and the purple dye,† which is so celebrated, they appear to have possessed the carrying trade of the world. Their skill in the management of commercial affairs is evinced by the account which Herodotus gives of their mode of barter with the Libyans, which was conducted with the greatest delicacy, and the most scrupulous honesty. (*Herod.* book iv.)

The colonial system of the Carthaginians seems to have been conducted in complete subservience to their commercial advantages. The want of an outlet for inhabitants formed no part of the motives which induced them to enter so largely on this system. The colonies were in most cases supported merely by a governor and a few followers, whom idleness, political discontents, or a love of change, tempted from their native country. Carthage received the rude produce of Sicily, Sardinia, and Spain, and exported in return its own manufactures, and those oriental commodities of which it formed the natural entrepôt. The colonies, after defraying their own expences, remitted the surplus revenue to Carthage, and their trade was confined exclusively to the mother country. An acute writer of our own day, (Brougham, *Colonial Policy*), has remarked, that the history of this monopoly exactly resembles that of the European nations who have colonised America. Polybius has preserved to us two treaties between Carthage and Rome, in which the progress of this monopolising spirit is distinctly to be traced. In the first, trading vessels have free access to all ports, both of the African continent and the colonies. By the second treaty, this privilege is confined to Carthage itself and to the ports of Sicily, but the Romans are absolutely debarred from Africa Propria and Sardinia, unless driven by stress of weather, in which case their stay is limited to five days. A singular clause is inserted, which bears a close analogy to the modern questions concerning goods contraband of war. "If any Roman shall receive water or stores from a Carthaginian port, or any part of the provincial territory of Carthage, he is bound not to turn them against the republic or her allies."

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* The great Hannibal is said to have been skilled in the Greek language, and to have written a history of Manlius Vulso's proconsulship in Asia.

Mago, another celebrated general, wrote a treatise on agriculture, in 28 books. Cicero speaks of him with praise. (*De Orator.* lib. i 249.) Varro relates that they were translated into Greek by Dionysius Uticensis; and Columella, that the senate, by a public decree, directed the translation of them into Latin.

Philinus, though born at Agrigentum in Sicily, is spoken of as a Carthaginian historian. Polybius complains greatly of his want of fidelity To Himilco and Hanno, both Carthaginian commanders, the ancients were indebted for the best accounts of the western shores of Europe and Africa.

Clitomachus, the successor of Carneades in the philosophical chair at Athens, was a Carthaginian by birth: Cicero speaks highly of him. (*Acad. Quæst.* lib. iv. 99. *Tuscul Quæst.* lib. iii 54.)

† The Carthaginian purple differed from the Tyrian; it was of a deeper tint; the Tyrian was of the colour of an unripe date. *Vid Salinas. ad Solin.* p. 1330, *et seq.*

Having thus noticed what is most important and peculiar relative to Carthage, its domestic policy, and external relations, we resume our summary view of its history:—premising, that of those circumstances which are not important, either in themselves or their consequences, our sketch will be slight and rapid, in order that we may be enabled more fully to describe events of superior importance.

The site of the infant colony appears to have been admirably chosen, and the new city flourished so rapidly, that Jarbas, a native prince, was induced to make himself master of it. He desired that ten of the most noble Carthaginians should be sent to him as ambassadors; to these he proposed himself as the suitor of Dido, and having induced them by threats and promises to enter into his views, he dismissed them. By an artifice they procured from Dido a promise to comply with their wishes; but she, to avoid the fulfilment of the contract, and the imputation of slighting the memory of her first husband, Sichæus, devoted herself to a voluntary death. This is Justin's account, and it evidently differs not a little from that which Virgil has given us. Much discussion has been employed to reconcile these differences; and Sir Isaac Newton (*Chronol.* p. 65.) seems inclined to favour Virgil's statement, from the idea that he might have had access to the archives of Carthage; and the arguments he brings forward, seem to render the statement that Dido and Æneas were contemporaries, more probable than the learned in general are willing to allow. However, the reasoning is far from conclusive, and we shall be content in this, and in all other instances, to follow the chronology of Blair, who places the destruction of Troy 408 years before the first Olympiad, (B. C. 1184.) while he brings the foundation of Carthage about 300 years later, (B. C. 869.)

How long the monarchical form of government continued at Carthage, we have no means of ascertaining, nor are we acquainted with any of the circumstances which befel the infant state. There is a chasm in the history of the Carthaginians of no less than three hundred years. Their progress in this interval could not have been slow; for from the first notice we have of their existence as a people in the ancient historians, (*Herod. in Clio. Thucyd.* lib. i. p. 11.) we find them in alliance with the Tuscans, bringing forward a fleet of 120 sail, and combating with the Phocæans, who had settled in the island of Corsica, in their progress from Asia to the southern shores of France. (B. C. 539.) The Phocæans were victorious; but Herodotus intimates, that the victory was in the end greatly detrimental to their interests. At about this period, also, the Carthaginians, as Justin informs us, (lib. xxiii. c. 7.) engaged in war with the neighbouring African princes, in which they were victorious by the skill and bravery of their general, Maleus, or as Vossius would correct it, Malchus. Under the command of the same general, they made, for the first time, a descent on Sicily, and subjugated a great part of the island. This event supplies a convincing proof, that they had now begun to be animated by that spirit of enterprise which afterwards rendered them so remarkable. Elated by their success in this instance, they proceeded to carry their victorious arms into Sardinia; though it appears that at the same time they were agitated by domestic discussions, and wasted by a most destructive pestilence. The attempt, however, was unsuccessful, Malchus was defeated by the Sardinians, and lost nearly the half of his forces. The citizens, enraged at his failure, indignantly pronounced a sentence of banishment against the general and all the surviving soldiers. The army, in the first instance, were contented with remonstrating against the injustice of this proceeding; but finding these remonstrances ineffectual, they embarked at once for Africa, advanced towards the city, and, having called the gods to witness that they were unwillingly driven to adopt these extreme measures, they held it closely invested. The senate and people now began to repent the folly and injustice of their proceedings, and were eager to come to an accommodation. At this time Curtalo, the general's only son, happened to return from Tyre, whither he had been sent to convey a tenth part of the Sicilian spoils as an offering to the Tyrian Hercules. Him they made their mediator, and he proceeded on his mission, clad in his robes, as priest of Hercules. His father, after rebuking him for his vain pomp, and for his disobedience in refusing to join him in the first instance, ordered him to be crucified. The citizens, dismayed by this act of resolute severity, surrendered immediately, and gave themselves up to the conqueror's mercy. He contented himself with ordering for execution ten of the senators, by whose advice the late violent resolutions had been undertaken. Thus peace was restored; but Malchus, soon after being suspected of aiming at the sovereign authority, was put to death.

The Carthaginian power was now rapidly increasing; for Herodotus informs us, (lib. iii.) that Cambyses, in the sixth year of his reign, was desirous of making an expedition against Carthage, but he was compelled to abandon his design, because the Phœnicians refused their co-operation, alleging in excuse, their intimate connection with the Carthaginian people. (*Polyb.* lib. iii.) In the first year after the expulsion of the kings, (B. C. 509.) the Carthaginians sent ambassadors to Rome, and concluded a treaty with that people. The objects of this treaty, as we have stated above, were purely commercial; and its regulations are in the highest degree curious and important. It is preserved to us by Polybius, who professes to have copied it from an ancient document existing in his time. The treaty appears to have for its object the entire exclusion of the Romans from any connection with the richer and more fertile parts of the Carthaginian territories, whilst it leaves open the colonies and the capital. The successor of Malchus in his influence and office was Mago, the founder of that most powerful family from which sprang the illustrious Hannibal. Justin (lib. xxx. c. 1.) has transmitted to us the most favourable character of him: under his auspices the affairs of Carthage flourished both at home and abroad, and its army was for the first time reduced to a state of discipline and subordination. His two sons, Hasdrubal and Hamilcar, succeeded to his power in the state. Under these leaders, a war was begun with the Sardinians, probably with a view of confirming the Carthaginian power in that island, which appears to have been but imperfectly established; however, they seem not to have made good their object; for Hasdrubal was slain, and we have no account of the success of his forces. It must have been about this time (B. C. 495.) that Darius Hystaspes sent that embassy to Carthage, of which we have before made mention. Its object was to reduce the Carthaginians to abstain from human sacrifices; from the custom of eating dog's flesh; and from the practice of entombing their dead. He added a request, that they would co-operate in the war he then meditated against Greece. It is in Justin only that we find an account of these various circumstances; and he neglects to inform us on what pretext the Persian king thus ventured to interfere in the domestic policy of an independent state. He adds, that the Carthaginians were eager to comply with the former stipulations, as from the situation of their own affairs, they were compelled to decline taking any part in the war.

Some years afterwards, the Grecian colonies in Sicily, finding themselves harassed by the Carthaginians, applied for assistance to the Spartans, (*Justin*, lib. xix.) The application was fruitless; nevertheless Gelo, who had (B. C. 491.) obtained the sovereignty in Syracuse, not only made resistance to their aggrandizement, but even extended his own dominions.

The embassy of Darius, mentioned above, seems to have produced some effect; for, in the third year of his successor Xerxes, (B. C. 483.) we find (*Herod.* lib. vii.; *Diodorus*, lib. xi.) an alliance offensive and defensive entered into between the two states, in which it is stipulated, that the Carthaginians should invade Sicily with all their forces, at the same time that Xerxes proceeded, with all the strength of the Persian empire, to attack Greece itself.

In pursuance of these engagements, the Carthaginians made vast preparations for the war. Xerxes supplied them with immense sums of money; yet the armament was so enormous, that three years elapsed before it was completely equipped. All things being at last in readiness, they set sail with an army of 300,000 men, principally mercenaries, a fleet of more than two thousand ships of war, and three thousand transports. The commander of this mighty force was (according to Justin,) the same Hamilcar, brother to Hasdrubal, and son of Mago, of whom we have before spoken; but Herodotus calls his father Hanno. The fleet was partially scattered by a storm, and the commander's baggage was entirely lost; which the Carthaginians, with their characteristic superstition, considered as ominous of the misfortunes which ensued. They landed at Panormus, and after three days rest advanced to Himera. Hamilcar prosecuted the siege with great vigour; he was attacked in his trenches by the combined forces of the Sicilians, under Gelo and Theron; the former of whom had lately usurped the supreme authority at Syracuse, the latter at Agrigentum. The battle was severely contested, but it ended in the complete annihilation of the Carthaginian army. According to the statement of the historians, not less than one hundred and fifty thousand were killed, and the remainder compelled to surrender at discretion. Hamilcar perished with his troops. Herodotus gives a very extraordinary account of the manner of his death. He describes him, as employing himself during the action in heaping up human victims; and when he found the battle was irrecoverably lost, he himself rushed into the midst of the flames. The loss of the Carthaginians was not confined to their land forces, the conquerors quickly made themselves masters of the fleet; twenty ships which had been left afloat, set sail for Carthage, but were lost in the passage, so that only a single boat escaped to tell the news. It should be observed, that Herodotus (lib. vii.) gives another account of the cause of this war, which he said he received from the Sicilian writers of his time. This would represent the war as undertaken for the purpose of restoring one Terillus, who had been ejected from Himera by Theron the tyrant of Agrigentum. This might perhaps have been one of the collateral motives, but it is surely in itself inadequate to account for the magnitude of the Carthaginian preparations.

Gelo conducted himself with great moderation; he granted peace to the Carthaginians, on the very easy conditions that they should pay 2000 talents of silver towards the expences of the war; and secondly, that they should build two temples,* in which the tablets containing the conditions of the treaty might be consecrated; and thirdly, that they should cease to offer human sacrifices.

When the Carthaginians began to look abroad after this terrible overthrow, their attention was again attracted towards Sicily. A dispute between the cities of Egista and Selinus supplied them with a pretext. Hannibal, the grandson of Hamilcar, (*Diodorus*, lib. xiii.) who was at this time one of the Suffetes, had ascendency in their commonwealth, and under his command they again hazarded all their force, upon the chances of a Sicilian campaign. He landed (B. C. 409,) near the promontory of Lilybæum, and advanced to Selinus, which, after a vigorous resistance, he took by assault. He appears to have treated this city with an excess of barbarity, which even Carthaginian ferocity does not prepare us to expect. Sixteen thousand of the inhabitants were put to the sword, five thousand were carried away captives, and the miserable remainder escaped to Agrigentum. The city itself was utterly destroyed. Himera was his next object, not only from its importance, and from its unvarying animosity to the Carthaginians, but as it was the scene of his grandfather's overthrow, he was eager to subdue it. The citizens made a most desperate but ineffectual resistance. Diodorus has given minute details of this siege, which are highly curious, as they afford information of the state of military science at this period. The city experienced the same fate as Selinus; and Hannibal, leaving a small body of troops to assist the confederates, before the conclusion of the year returned to Carthage, where he was received with the most distinguished honour.

The Carthaginians were so elated with their recent success, that they seriously meditated the conquest of the whole island of Sicily. They made the greatest preparation for this renewed attack; and having joined Hamilcar, the son of Hanno, in commission with Hannibal, who, from his age and infirmities, was unequal to the various duties of the chief command, the expedition set forth.

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* Raleigh has made a curious mistake in his account of this treaty, he has translated the word ναȣς, ships, instead of temples

Their first object was Agrigentum, a city second only to Syracuse. (*Diod. Sic.* lib. xiii.) The Sicilians had not been negligent in their preparations to oppose this formidable invasion; in consequence, the Carthaginian generals had scarcely time to form the siege, before they were attacked by a force which the Syracusans sent to the assistance of their allies, under the command of Daphneus. Hamilcar detached a force to oppose them, but they were completely worsted; and, had the garrison availed themselves of the opportunity, the whole army might have been completely destroyed. They had reason to repent of this negligence; for Hamilcar, having corrupted a part of the garrison, and received information that the remainder were distracted by jealousies and dissensions, carried the place by storm; and, as usual, put the inhabitants to the sword, and pillaged the whole city.

The Syracusans now began to contemplate with alarm the progress which the Carthaginians had made. The domestic dissensions which ensued in consequence of this alarm, gave Dionysius an opportunity of assuming the sovereign power. Hamilcar next proceeded to ravage the territories of Camarina and Gela. He laid siege to the last city, and Dionysius in vain endeavoured to relieve it. The inhabitants, by a successful artifice, escaped, and left the city to the mercy of the conqueror. Camarina shared the same fate; but Hamilcar finding his army weakened, partly by the cruelties of war, and partly by a destructive pestilence, offered terms of peace to the conquered. The offer was gladly accepted by Dionysius, and a treaty was immediately concluded. The terms were, that Carthage should retain all her conquests in full sovereignty, except Gela and Camarina, for which she was to receive tribute. The independence of the other Sicilian states was stipulated, and the authority of Dionysius was completely acknowledged. That crafty tyrant availed himself of this interval of repose, to strengthen his power at home. Having freed himself from all who could oppose his inordinate ambition, he again turned his thoughts to wiping off the stain which his reputation had received by the success of Hamilcar. As soon as he had strengthened the fortifications of Syracuse, he began to collect from every quarter all that could be necessary for his naval and military equipments. Diodorus has given us a minute detail of these preparations, and they appear to have been most formidable. When he was ready to take the field, Dionysius convened the senate of Syracuse, and announced his intention of attacking the Carthaginians instantly, without any previous declaration of war. The assembly were induced to enter into his views, and in consequence the persons and property of all the Carthaginians, who, upon the faith of treaties, were resident in the Sicilian states, were at once abandoned to the fury and avarice of the populace. The first account of these affairs was conveyed to Carthage by a message from Dionysius himself. The city was then wasted by the plague, but the wonted spirit of the inhabitants was not abated. They distributed several sums of money for the purpose of procuring troops, and dispatched orders to their garrisons in Sicily to be vigilant in watching the motions of Dionysius, and appointed Himilco commander in chief of their forces.

Dionysius, in pursuance of the plan he had laid down, without waiting for an answer from Carthage, at once attacked Motya, a celebrated Carthaginian colony, near Mount Eryx. He succeeded in carrying the place by surprise. The resistance of the inhabitants and garrison was, as usual, most obstinate. Sieges were at this time seldom undertaken with any other view than that of plunder. In consequence, the garrison was always roused to that excess of valour which is the natural result of despair. Capitulation was invariably followed by indiscriminate pillage, and the most dreadful slaughter. There is, besides, something in the circumstances of a siege, which, beyond all other motives, gives birth to the most obstinate valour. Every age and every country can produce its examples of this; and it may safely be asserted, that were it not for the celebrated sieges, of which we have authentic accounts, we should still be ignorant of what extent men are capable of acting or of suffering.

The Carthaginians, undismayed by this inauspicious beginning, maintained the war with their usual energy. After several alterations of good fortune, both by sea and land, Himilco so far succeeded in recovering from the effects of the first blow received in the war, as to invest Syracuse with a large army. He had already possessed himself of the suburb of Acradina, and had suffered himself to be elated by the warmest expectations of complete success; when a pestilential fever, perhaps the most malignant recorded in history, broke out among his forces. In a very short time it carried off not less than 150,000 men. Dionysius, apprised of the miserable state to which they were reduced, made a most vigorous sally, possessed himself of the Carthaginian approaches, and burned a great part of their fleet. Himilco, reduced to extremity, came to a private agreement with Dionysius. For three hundred talents he obtained permission to depart in the night to Africa, with all the citizens of Carthage. The miserable remains of the confederate forces, with all their baggage and stores of their camp, were abandoned to the conqueror. (*Diod. Sic.* lib. xiv.; *Justin.* lib. xix. c. 2.)

Diodorus has left us a most minute account of the symptoms which accompanied this most horrible disorder. It is not easy to understand whether it was communicated by infection from Africa, or whether it was caused by any temporary and local circumstances; probably by the latter, as the army was encamped in the midst of a swampy unwholesome country; and it is mentioned, that the heats, at the time when the pestilence broke out, were greater than had ever been known.

Carthage was overwhelmed with despair at the news of this dreadful disaster. Himilco, with the wretched companions of his misery, was received every where with tears, and groans, and every expression of grief. Not being able to endure the bitterness of his misfortunes, he determined not to survive it. But the distresses of Carthage did not stop here. Their African allies, enraged to hear that their countrymen had been abandoned to the mercy of the enemy, while the Carthaginian citizens had returned to their homes, resolved to revenge the injury. They collected an army of 200,000 men, with which they marched to Carthage. The sudden impulse of feeling which had drawn them together, happily for the Carthaginians quickly subsided; want of provisions produced discontent; and the whole force very soon melted away, without effecting any thing of importance.

The Carthaginians still struggled to maintain their footing in Sicily. Within two years they had assembled another army, which they entrusted to the command of Mago. Dionysius drew him into a snare; and the Carthaginians, reduced to extreme distress from the want of supplies, were saved only by a sedition which arose in the Sicilian camp. A treaty ensued precisely the same with the last, except that the town of Taurominium was ceded to Dionysius. A peace of nine years continuance followed, which was again broken by the restless ambition of Dionysius; another sanguinary war succeeded, and after it, as usual, a hollow and suspicious peace. At length death relieved the Carthaginians from this implacable foe. Dionysius was carried off by the effects of a debauch. He was succeeded by his son in the government of Syracuse. (*Diod. Sic.* lib. xv.)

Habitual indolence induced the younger Dionysius to maintain the peace inviolable, so long as his influence continued; but the Syracusans being torn by intestine commotions, the Carthaginians persuaded themselves that they had a good opportunity of accomplishing their favourite object, the reduction of the whole island. (*Plut. in Vit. Timol. Diod. Sic.*) The Syracusans applied to Corinth for assistance, from which state they were supplied with a body of troops under the command of the celebrated Timoleon. (B. C. 341.) It would be some relief to the mind, wearied with contemplating this unvarying series of cruelty and perfidy, if it could dwell for a short time on the character of this illustrious person; but the limits of this work forbid it.

Timoleon, though opposed by a superior force, made good his landing in Sicily, at Taurominium. Andromachus, the father of Timæus the celebrated historian of Sicily, then possessed that doubtful sort of authority at Taurominium, which the ancient historians describe under the general name of a *tyranny;* by which they, for the most part, intend to signify an ascendency in the public affairs, obtained and preserved only by the weight of talents and personal character, which controuled the laws, while it affected to act in subserviency to them. In the commonwealth of Greece, instances of this sort of authority are continually occurring. It supplies an unanswerable argument against the theories of the speculative republican, when we find the democracies of Greece, each in its turn, yielding to this kind of authority; and Rome, in every period of hazard and public calamity, compelled to have recourse to the necessary but perilous authority of a dictator. The nature of this tyranny seems to have depended on the personal character of him who possessed it. Nothing could have been more hateful than the authority which Dionysius exercised, whilst the sway of Andromachus, in his city Taurominium, seems to have been most gentle, and most salutary. He governed, says Plutarch, (*ηγειτο*) with justice, and according to law. The Carthaginians threatened Andromachus with their vengeance, unless he dismissed Timoleon from his territories. (*Plut. in Vit. Timol.*) Plutarch has preserved the form of the menace, which is so striking, and so characteristic of those oriental manners, with which the Carthaginians were still imbued, that it should not be passed over. The messenger stretched out his hand with the palm upward, and then turned it over, implying that Taurominium should be treated in the same manner. Andromachus appears to have estimated the menace as it deserved: he steadily adhered to the party which he had espoused; and thus gave occasion to that rapid and glorious career, which places Timoleon amongst the most celebrated commanders of antiquity. Dismayed by the rapidity of Timoleon's first movements, the Carthaginian commander abandoned his cause with inglorious precipitation. He returned to Carthage, where, finding the tide of popular opinion strong against him, he put an end to his life. (*Plut. ubi sup.*) In the following year, the Carthaginians exerted their utmost strength to crush the increasing power of Timoleon, and recover their former influence in Sicily. Seventy thousand land forces, two hundred ships of war, and a thousand transports, with a vast equipment of military stores, were entrusted to the care of Asdrubal and Hamilcar. Timoleon had not passed the interval in idleness, the art of war was progressively becoming more an object of attention amongt the Grecians, and Timoleon was one of those who had most successfully cultivated it. His forces scarcely amounted to 7000, and even these were greatly weakened by desertion as the season advanced. The armies met near the river Crimisus, and the Carthaginians had now to experience for the first time, the inefficacy of their numbers, when opposed to a general of disciplined valour and consummate skill. (B. C. 340.) Their immense army met with a complete overthrow. Ten thousand were left in the field of battle, and the conquerors were enriched by the plunder of their wealthy camp. Disconcerted as they were by these repeated overthrows, the Carthaginians still made a shew of renewing their efforts; but their preparations seem to have been continued only for the purpose of giving effect to a negociation which they had already entered upon with Timoleon. A peace was the consequence, of which the most important condition was, that the river *Lycus* should in future be the boundary of the Carthaginian territory in Sicily; and the Carthaginians pledged themselves to abstain from all interference with the independent states of Sicily. It is to this period we must refer the attempt of Hanno to subvert the constitution of Carthage, and institute arbitrary power. Justin (lib. xxi. c. 4.) gives us the account at some length; but, as is common to him, the narrative is obscure and inconsistent. Hanno's plan was to assemble the whole senate, on pretext of assisting to celebrate his daughter's marriage, and by mixing poison with their wine to destroy them all. The plot was discovered; but as he was too powerful for the senate to dare at once to punish him, they contented themselves with counteracting his scheme, by passing a law to regulate the expence and magnificence of wedding feasts. Hanno, finding that suspicion was awakened, retired with 20,000 of his slaves to his country seat; he afterwards yielded to the superior forces sent out against him, and expiated his infatuated ambition by a cruel death.

The attention of the whole world was now excited by the surprising successes of Alexander. (*Justin*, lib. xxix. c. 6.) Carthage could not regard them with indifference; the destruction of Tyre, and the transfer of its commercial greatness to Alexandria, which it was boasted would speedily become the emporium of the world, excited their fears lest the forces which had overrun the whole East should be turned to their shores, and that Africa should be called upon to cope with those veteran troops which Asia had in vain endeavoured to resist. They adopted a scheme not unworthy of their national character. They selected one Hamilcar, (surnamed Rhodanus,) a man eminent for his eloquence and skill in negociation, who, representing himself as an exile from his native country, procured, through the intervention of Parmenio, an introduction to Alexander, and obtained permission to accompany him in all his expeditions. He was thus enabled to do his country signal service, by communicating all Alexander's plans, and appears to have managed this most difficult duty with the utmost address; nevertheless his barbarous and ungrateful country requited him by a cruel death, upon a charge that he had failed to do all that was in his power.

After a few years, we find the Carthaginians again embroiled in the affairs of Sicily.

Agathocles, (*Justin*, lib. xxii. c. 1. *Diod. Sic.* lib. xix. sub init.) by an almost singular union of courage, artifice, and good fortune, had raised himself from the lowest condition to the sovereignty of Syracuse. But this unhoped for advancement failed to satisfy his ambition. By degrees he contrived to make himself master of the Grecian dependencies in Sicily, and now threatened to become to the Carthaginians a more formidable opponent than they had hitherto been called on to encounter. In the first instance, his cause had been espoused by the Carthaginian commander in Sicily; but the senate quickly saw the impolicy of this conduct, and found that they were fanning a flame by which themselves would in the end be consumed.

They determined to strengthen their forces in Sicily; a considerable reinforcement was therefore dispatched, but the fleet was overtaken by a storm, and many ships of war and transports were lost. Notwithstanding this severe reverse, the Carthaginian general found himself at the head of 40,000 foot, and 5000 horse. With these he succeeded in defeating Agathocles near Himera, (B. C. 309). Their success in this engagement was principally owing, as Diodorus (lib. xxx.) informs us, to the skill of the slingers from the Balearic Isles. This victory involved many important consequences. All the principal places yielded to the conqueror, and Agathocles, in despair, shut himself up in Syracuse. The Carthaginians invested the place with their whole force; when Agathocles, finding himself deprived of all resources, and on the point of falling into the enemies' hands, adopted the spirited and almost incredible determination of carrying the war at once into Africa. The mouth of the harbour was closely blockaded by the Carthaginian fleet, yet Agathocles watched his opportunity so artfully, and availed himself of circumstances so adroitly, that he managed to elude their vigilance, and sailed straight for Africa. The Carthaginian admiral was not slow in the pursuit, but did not come up with the Syracusan fleet till they were in sight of the African coast. A partial engagement ensued, but Agathocles was not to be diverted from his main object; he made good his landing, and then, under pretence of fulfilling a vow he had made to Ceres and Proserpine, he set fire to his ships. (*Justin.* xxii. and *Diod.* xx.)

The consternation at Carthage, when the news of this descent of Agathocles arrived, was excessive. The flower of their army was in Sicily; their city was wholly unprepared for defence, and the country, which had now for a long period been exempt from the calamities of war, was filled with dismay and confusion. Agathocles advanced to Tunis, and ravaged the whole neighbourhood of Carthage. In this conjuncture, Hanno and Bomilcar were appointed to command the forces, which had been hastily brought together; and eager to check the tyrant's destructive ravages, they instantly took the field. They advanced with no small confidence, for their army consisted of forty thousand, while that of Agathocles did not amount to fourteen thousand men. This confidence was their destruction; they were routed. Hanno was slain, and Bomilcar, with difficulty, drew off the shattered remains of his army. Diodorus attributes this discomfiture in a great degree to the treachery of Bomilcar, who covertly aimed at the sovereign authority, and who wished to convert this invasion of Agathocles into an instrument for effecting his design.

The citizens of Carthage were extremely disheartened by the result of this engagement, as they persuaded themselves that the tutelar deities of their country must have taken part against them. To appease these offended deities, they resolved to renew their offerings to the Tyrian Hercules; and as they had failed in the exact performances of the sacrifices to Saturn, they made horrible atonement, by selecting two hundred infants of the noblest families for immolation; and more than three hundred persons of both sexes voluntarily offered themselves victims to their bloody idol.

They then dispatched messengers to Hamilcar, who commanded in Sicily, requiring him to come to the relief of his country: he does not, however, seem to have been aware of the extreme urgency of the case, as he contented himself with dispatching 5000 men. By pressing the siege of Syracuse, he thought to draw Agathocles from his purpose; but in an attempt to surprise it by night, he was slain, and his troops completely discomfited.

In the mean time Agathocles had made himself master of all the open country, and Carthage itself must have fallen, had it not been for a mutiny which broke out in the invader's camp. (*Diod.* xx.) He succeeded indeed in quelling the mutiny, but by it his efforts were crippled, and he was constrained, instead of assaulting the capital itself, to be content with endeavouring to detach the tributary states from its interests. He contrived also to delude Ophellas, one of Alexander's captains, who had established himself in Cyrenaica, to co-operate with a large army; promising to assist him in becoming sovereign of Africa. Ophellas (*Diod. ubi sup.*) little suspected the snare that was laid for him; he joined Agathocles with a considerable force; but Agathocles caused him to be assassinated, and persuaded the troops of Cyrenaica to enrol themselves under his standard. A transaction at this time was taking place at Carthage, which, if Agathocles had received timely information, would have enabled him to put an end to the war. Bomilcar, to whose treachery the loss of the last battle had been attributed, now began openly to avow those designs of which he was then only suspected. He endeavoured, with the assistance of some mercenaries, whom he had contrived to assemble, to get forcible possession of the chief authority in Carthage. His scheme was, however, frustrated, and he himself crucified in the midst of the forum. He endured his sufferings with great constancy; and from the cross he harangued the multitude, and upbraided them with their ingratitude to so many illustrious commanders. The singular good fortune of Agathocles now began to forsake him. The Carthaginian party in Sicily made such rapid progress, that he determined to leave for a season the management of affairs in Africa, and to return to Sicily. His return to Sicily was as fortunate as he could have hoped; but he was quickly recalled, by the news that his son Archagathus had been twice defeated by the Carthaginians, and that he laboured under the most severe want of provisions. With his usual activity, he returned on the instant to Africa; his troops were sunk almost into a state of despair from want of food; he found himself therefore reduced to the necessity of engaging immediately, and the consequence was an entire overthrow. The tide of fortune had now ebbed so low with him, that his only anxiety was to save himself from falling into the hands of the Carthaginians. He succeeded, after great exertion, in effecting his escape, but he left his children and his remaining troops to the mercy of the conqueror. Enraged to find themselves thus deserted, they put to death the tyrant's sons. The Carthaginians, however, were well pleased to grant them very easy terms, and purchased the cession of those strong places which were still in their hands, at the price of 300 talents; engaging to give those who were unwilling to enter into their service safe conduct to Sicily. This treaty was in the following year ratified by Agathocles, with an additional article, which, availing themselves of his necessities, they extorted, viz. that all those cities which they had formerly possessed in Sicily should be restored to them. Thus did these most extraordinary wars, which had threatened the destruction of the Carthaginian name, terminate in the disappointment and discomfiture of their enemy. Their effects, however, did not cease here; the success of Agathocles gave to the Romans the first notion of the practicability of invading Africa; and Livy (lib. xxviii. c. 43.) makes Scipio expressly quote this example, to justify the opinion he had given, that the war might with advantage be transferred to the enemy's country. Diodorus is so strongly impressed with the importance of these occurrences, that he goes out of his way to point out the peculiar circumstances, which shew the intervention of an over-ruling Providence.

Agathocles, however, did not entirely forego his animosity to the Carthaginians; and he was making preparations for another war, when death put an end to his plans; (B. C. 298,) and gave to Sicily a period of tranquillity to which it had so long been a stranger.

Circumstances now began to connect the Carthaginians and Romans with each other, and gradually gave birth to those jealousies which, in the end, produced such important consequences. The arrival of Pyrrhus in Italy, equally alarmed both nations, and induced them to renew their existing treaties with an additional article, by which they agreed mutually to support each other against the designs of that prince; and not to enter into any separate treaty with him, inconsistent with this defensive alliance: and it was further stipulated, that the Carthaginians should furnish the whole of the shipping, both transports and armed galleys; but that the expense of every armament should be defrayed by that party in whose defence it was employed. In compliance with the terms of this treaty, they dispatched a fleet of 120 sail, under the command of Mago, to the assistance of the Romans, as soon as they had learnt that Pyrrhus was actually landed: (*Justin*, xviii. c. 2.) This assistance the Romans declined. Mago then had an interview with Pyrrhus, in order to fathom his intentions with regard to Sicily, of which state the Carthaginians were now very jealous. Nor was this jealousy unfounded: within a very short period Pyrrhus received an invitation from the Syracusans to come to their assistance against one Macnon, who was supported by the Carthaginians in his endeavours to usurp the supreme authority. Pyrrhus very gladly availed himself of the opportunity; he was happy to have a pretext for quitting Italy; and his vanity was flattered by finding himself called upon to be the defender of the Grecian colonies. Having sent Cyrus before him to arrange the terms of his reception, he set sail from Tarentum with a powerful fleet, and in a few days landed at Tauromininum, where he found himself at the head of 30,000 foot, and 2500 horse, exclusive of his Sicilian auxiliaries. The Carthaginians were then occupied in the siege of Syracuse, which they immediately abandoned. Agrigentum expelled the Carthaginian garrison, and opened the gates to the conqueror; Eryx was taken by storm, and no town of any importance remained to the Carthaginians except Lilybæum. This city had always been esteemed one of the keys of Sicily, and the exertions made in defence of it, were proportionate to its importance. The Carthaginians were, however, so cast down by the king's previous successes, that they offered to abandon all their claims on Sicily, if he would allow them to retain Lilybæum. Flushed with good fortune, Pyrrhus rejected the offer: a conduct he had reason to repent, for he was compelled to raise the siege after he had pressed the town to the utmost. Disheartened by this failure, he determined, with his usual levity, to abandon Sicily entirely, and to set sail for Rhegium; but he was met at sea by a strong squadron, which had been fitted out on purpose to intercept him: thus he was constrained to adventure an engagement, in which he was so completely defeated, that he reached Locri with only ten ships, and from thence, with difficulty, marched to Tarentum. The Carthaginians immediately set about reducing the Sicilian towns, which had been before in their possession, and settled their affairs in Sicily upon a firmer footing than ever.

We have now reached that period when Rome and Carthage, which had for some time menaced each other from a distance, came actually in contact; when the great question, whether the seat of universal empire should be fixed in Africa or in Europe was decided. Before we enter into the detail of circumstances which gave rise to the first Punic war, it will be expedient to take a short survey of the actual state of Carthage, the extent of her dominion, and the nature of her influence.

The limits of the Carthaginian dominions in Africa had been progressively advanced, till they extended from the western borders of Cyrenaica to the Pillars of Hercules: but at this distance of time, and with our scanty means of information, it is impossible to trace the various stages of this progression. The period in which the Carthaginians first settled in Spain is involved in great obscurity; but as Diodorus intimates that the mines of Spain were the great nerve of the Carthaginian power, by which they were enabled to fit out such wonderful fleets, and bring such formidable armies into the field, we may conclude that they had established themselves in that country at a very early period, previously to the reigns not only of Darius and Xerxes, but also of Cyrus himself.

Justin states, that they were, in the first instance, led to intermeddle in the affairs of Spain, with a view of assisting that sister colony which the Phœnicians had established at Gades, (lib. xliv. c. 5.) The assistance afforded by them was effectual in defending it against the attacks of the neighbouring people; but not content with this, they managed to obtain possession of the colony itself, and of the whole province in which it was situated. This event probably took place about the middle of the second century, after the foundation of Carthage: for Diodorous distinctly states, (lib. v. c. 1.) that at this time a colony was established in Ebusus, (now Ivica,) and in all likelihood the whole of the Balearic islands were colonised at the same time: Now, it seems reasonable to suppose, that the advance of the Carthaginian colonization was progressive, and therefore that the settlement at Cadiz would be subsequent to that at Ebusus; hence, we may perhaps be allowed to infer, that the Carthaginians made their first descent into Spain about 160 years after the building of their city. Nevertheless, it appears, from the accounts of Livy and Polybius, that the greatest part of Spain remained unsubdued till the wars of Hamilcar, Asdrubal, and Hannibal.

In Sardinia, their settlements were almost coeval with their existence as a people: the whole island appears to have been in subjection to them at the period of their first treaty with the Romans.

Corsica, too, was occupied by them from very ancient times: they probably succeeded immediately to that colony which the Phocæans were compelled to abandon. Herodotus (lib. vii.) mentions the Corsicans among those nations which were united to form that vast armament with which the Carthaginians invaded Sicily in the days of Gelon.

The small islands of Melita and Gaulos (now Malta and Goza) were likewise in subjection to the Carthaginians. According to Diodorus, these islands were first peopled, either from Carthage or Phœnicia. (*Diod. Sic.* lib. v. c. 2.)

This rapid survey may suffice to give us some idea of the actual extent of the Carthaginian influence. The Romans, on the other side, had now begun to feel their strength, and were considerably elated by their recent success against Pyrrhus. That experienced commander foresaw the collision which was about to take place between these powerful rivals, and is said, upon leaving Sicily, to have pointed out that island as the subject and the first scene of the contest. (Plutarch, *in vit. Pyrrhi.*)

Notwithstanding the Carthaginians had been thus successful in dislodging the Epirots from Sicily, they had still two powerful enemies to contend with, the Syracusans and the Mamertines. The former had recently appointed Hiero for their leader, who is uniformly represented by the ancient historians as a consummate hero, and most amiable prince: under his command the Syracusan forces obtained several considerable advantages over the Carthaginians. (See *Justin*, lib. xxiii. c. 4.; Theocrit. *in Idyllio.* 16.; Pind. *in Olymp.* 1.)

The Mamertines were originally a body of Campanian mercenaries, which Agathocles had retained in his service. They were afterwards involved in a dispute with the citizens of Syracuse, as to their right of giving votes in the election of magistrates; the consequence of which was, an agreement that the Campanians should evacuate Sicily within a limited time. Under pretence of embarking for their native country, they retired to Messina, of which town they took possession by treachery, expelling or assassinating all the inhabitants, and assuming to themselves the name of Mamertini, a word which, in the ancient language of southern Italy, is used to signify a warlike people.

In this horrid action they soon found imitators: Some Roman troops, to the number of about 4000, had been posted at Rhegium, during the late wars in Italy, under the command of one Decius, a Campanian: these, assisted by the Mamertines, murdered the citizens, and seized their property; but they were speedily punished by the Romans with exemplary vigour. The Mamertines, on their side, were closely pressed by Hiero, who was eager to retaliate upon them the injuries they had committed. They were at length reduced to such distress, that they resolved to surrender themselves to the first power that could afford them protection; but being divided in their choice, one party made an offer of submission to the Carthaginians, another to the Romans. The latter scrupled to avow themselves the protectors of a crime which they had so lately punished; but while they hesitated, the Carthaginians, availing themselves of the delay, and of the neighbourhood of their own military stations, got the start of their rivals, and were received into Messina.* This unexpected advantage, gained by a power of which they had so much reason to be jealous, roused the Romans: they instantly sent orders to the consul Appius Claudius, who had charge of the forces in the neighbourhood of Rhegium, to assemble all the shipping which could be found on the coast, from Tarentum to Naples, and to pass with his army into Sicily. As soon as his fleet appeared, the party in the city which had favoured the admission of the Romans took arms, and forced the Carthaginians to evacuate the place. (*Polyb.* lib. i.)

Thus commenced the first Punic war. The first object of either party was no more than to command the passage of the straits, by securing the possession of Messina; but their views were gradually extended, and the contest quickly assumed its real form, a struggle for the sovereignty of the whole island and the dominion of the seas. Unfitted as the Romans were, both by their habits and by the nature of their resources, for a naval war, yet the commanding aspect of their first descent on Sicily, induced Hiero to unite with them. The small force which Appius had so hastily transported, was replaced by two consular armies; these were sufficiently powerful to make Hiero tremble in his capital; he had also grounds for suspecting the intentions of the Carthaginians towards him, and he was influenced perhaps by that hereditary animosity which the people of Syracuse must have felt against the Carthaginian name. All or any of these reasons may be sufficient to account for the line of conduct pursued by him. The accession of Hiero to the Roman cause, altered the whole character of the war. It enabled the Romans to plan and to execute designs which, under other circumstances, must have been impossible. The Carthaginians were not dispirited by this sudden change; they made new levies in Gaul and Liguria; reinforced their armies; and fixing on Agrigentum as their principal military station, they appointed Hanno commander of their forces. The Roman army was engaged in the siege of Agrigentum when Hanno assumed the command; he immediately led his troops to the relief of the place. A severely contested battle ensued, in which the Romans were victorious. The possession of Agrigentum was the first fruit of their victory; it served also to establish the wavering fidelity of Hiero, and confirm his adherence to the cause he had espoused. (*Polyb.* lib. i. p. 29. Edit. Casaub.)

The Romans perceiving that, notwithstanding their success by land, their coasts of Italy still continued open to the depredations of the Carthaginian fleets, resolved at once to equip a fleet which might enable them to cope with their foe, even on his own peculiar element. This attempt, so bold in its conception, and so important in its ultimate consequences, induced Polybius, (as he himself states,) to write the history of this war, "in order that the circumstances which attended the first formation of the Roman marine might never be forgotten." A Carthaginian vessel, which had been accidentally stranded at Messina, served them for a model, and within the short period of sixty days, they had fitted out, and manned for sea, 100 gallies of five benches of oars and twenty triremes. These vessels were extremely rude, both in their materials and construction, yet the labour of building them must have been immense, as a quinquereme was capable of carrying 300 rowers and 200 fighting men.

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* No expression can be stronger than that used by Polybius, *μηδ' ἐᾶσαι Καρχηδονιους ὁιονει γεφυρωσαι την εἰς Ἰταλιαν ἀυτοις διαβασιν.*

While the gallies were building, the Romans exercised their rowers on benches erected on the beach. And in order to counterbalance the advantage which the Carthaginians were likely to derive from their superior seamanship, they invented, (or rather in the opinion of some writers, improved,) the machine called the *corvus*, by which they were enabled to grapple and bind the vessels together, so as to give to their soldiers full scope for the exertion of their bodily strength and activity.

In the first rencontre of the hostile fleets, the Carthaginians were, as it might be expected, successful; but in a subsequent engagement, they met with a severe check, and their admiral, Hannibal, having lost the greater part of his ships, with difficulty made his escape. The command of the Roman fleet had now devolved upon the consul Duilius, to whom is attributed the invention of the Corvus. He engaged the Carthaginian fleet without delay, and by the help of his new engine succeeded in giving them a complete overthrow. (B. C. 260.) The loss of the Carthaginians is variously related; Hannibal, having been obliged to abandon his own vessel to the enemy, returned to Carthage, where he obtained reinforcements for his shattered fleet. Putting to sea again, he steered for the coast of Sardinia, where he was surprised by the Romans while at anchor, who carried off some of his ships, and took great numbers of his men prisoners: this so incensed the rest, that they seized their admiral and crucified him. The affairs of the Carthaginians in Sicily had, in this interval, assumed a more favourable aspect. Hamilcar, their commander, availing himself of a dispute which had occurred between the Roman legions and their auxiliaries, surprised their camp, put four thousand to the sword, and dispersed the rest. Notwithstanding this disaster, the terror of the Roman arms was still sustained by the vigilance and bravery of the consul Florus, while his colleague Cornelius Scipio, made a descent on Corsica, and menaced the coasts of Sardinia. Several engagements, both by land and sea, ensued, with various results, but for the most part to the advantage of the Romans, who were thus, by degrees, encouraged to prepare for an invasion of Africa itself, as the only means by which they could oblige the enemy to evacuate Sicily. (*Polyb.* lib. I. p. 22.) In the ninth year of the war, the consuls Manlius, Dulso, and Attilius Regulus, with the fleet under their command, consisting of 350 gallies of different sizes, held their rendezvous at Messina. Having taken their land forces on board, they proceeded along the coast. The Carthaginian fleet, which, as to the number of vessels, was about equal, was lying at Lilybæum, under the command of Hanno and Hamilcar. The hostile squadrons met near Heraclea Minoa. The Roman commanders drew up their fleet in the form of a wedge, the Carthaginians were in line. The consuls observing that this line was weak towards the centre, caused it to be vigorously attacked in that part. A most obstinate conflict ensued, which terminated in favour of the Romans, who lost in the action only 24 gallies, whilst the Carthaginians had 30 sunk and 63 taken. After the battle, Hamilcar sent Hanno to make proposals of peace to the consuls, which being rejected, the war continued to rage with as much fierceness as ever; and the consuls soon after setting sail for Africa, landed without opposition near Clupea; or, as Polybius calls it, Aspis. Nothing could exceed the terror and astonishment which the news of the Roman invasion caused at Carthage. These were, however, in some degree diminished by the intelligence that, contented with ravaging the whole country almost to the very gates of the capital, one of the consuls had returned to Rome with the best part of the troops, leaving the management of the war to his colleague Regulus, with only 40 ships, 15,000 foot, and 500 horse. Hamilcar was recalled from Sicily, and was joined with Asdrubal and Bostar, in the command of the army. Regulus having spent the winter at Clypea, hearing that the Carthaginian army was in motion, advanced with his forces, and encamped upon the Bagrada in the neighbourhood of Carthage. Here he is said to have met with that monstrous serpent, of which several ancient writers make mention: the descriptions are probably hyperbolical, yet it is impossible to refuse all credit to a story for which there are so many authorities. (*Val. Maximus.* lib. i. c. 8. *Liv. epit.* lib. xxx.)

The Carthaginian generals advanced to give him battle, but most unwisely took up a position in ground that was unfit for the operations of elephants or horse, in which the great part of their strength consisted. Regulus profited by this mistake, attacked them in the night, and entirely defeated them. This victory was productive of the most important consequences; Utica opened its gates, Tunis was forced to submit, and nothing now remained but to lay siege to Carthage itself.

To complete the misfortunes of the Carthaginians, their territory was, at this time, invaded by the Numidians, who committed the most dreadful ravages. The Roman consul, elated by his good fortune, and desirous to terminate the war before the arrival of a successor, offered to treat with the vanquished, but on terms so extravagant, that they were at once rejected by the senate.

At this conjuncture, a Carthaginian officer who had been sent to Greece to levy soldiers, returned with a body of mercenaries, amongst whom was one Xantippus, a Spartan, who had some reputation for military science. To him the command of the remaining forces was entrusted; and he succeeded in infusing into them some knowledge of the Grecian tactics, and an unbounded confidence in his own skill and experience. Regulus was little prepared for this change; when he saw the Carthaginian army again advancing, flushed with the hope of new victories, he at once led his men to the attack, and ventured even to cross the river which separated the two armies. This rashness led to the entire destruction of his army. Xantippus profited to the utmost of his antagonist's misconduct, and only two thousand of the Romans escaped from the field. Regulus himself was taken prisoner. The Carthaginians treated all their captives with great humanity, except the general. The story of his sufferings and constancy is well known.

Xantippus, to whose conduct the whole of this success must be attributed, withdrew from Carthage immediately afterwards. "Wisely and prudently, (says Polybius,) as the splendour of his action must have excited a degree of jealousy and envy sufficient to overwhelm even a citizen; how much more a stranger and a foreigner." (*Polyb.* p. 37. Appian. *in Libycis*, *sub init.*)

The Romans sent out a strong squadron to bring off the remains of the defeated army; but in the passage to Sicily on their return, they met with a dreadful tempest, in which they lost almost their whole fleet. This, and several subsequent calamities, so greatly dispirited them, that they determined for a season to lay aside all naval operations. The Carthaginians were thus left masters of the sea. The theatre of war was now again removed to Sicily, where it raged with unabated violence. The affairs of the Carthaginians were in a state of progressive deterioration, till the appointment of Hamilcar, surnamed Barcas, to the chief command. His valour and enterprise restored for a short time the drooping fortunes of his country, but in the end he was obliged to yield. The Romans had soon become sensible of the absolute necessity they were under of restoring their ships; and they did so with a resolution and vigour which enabled them once more to prevail over the superior skill and address of their enemy. Another defeat at sea compelled Hamilcar to seek for peace. (B. C. 242.) It was granted, but upon conditions so harsh, and dictated by the Romans with so much insolence, that Hamilcar from that moment conceived an invincible aversion to the Roman name. He concluded peace, only that he might give his country time to breathe, and that they might afterwards be able to chastise the insolence to which they were at present compelled to submit. The terms of peace were these: That the Carthaginians should evacuate Sicily; that they should not, for the future, make war on Hiero king of Syracuse, or any of his allies; that they should release all Roman captives without ransom; and within twenty years, pay to the Romans a sum of three thousand Euboic talents.* The people of Rome refused to ratify this treaty, till they had sent ten commissioners into Sicily to examine into the actual state of affairs. By these, some additional articles were added of inferior importance, but still harsher tendency. The ratifications were then interchanged, and Asdrubal retired to Lilybæum, where he resigned to Gisco the care of transporting the troops to Africa. (*Polybius ubi supra.*)

Thus, after twenty-three years continuance, ended the first Punic war; leaving the contending parties weakened, indeed, but not dispirited;—with their resources exhausted, but their mutual animosity increased and exasperated beyond measure. The excellent Polybius, in a recapitulation of the most remarkable circumstances of the contest, gives the preference to the Roman soldiers above the Carthaginian; but at the same time he allows, that Hamilcar Barcas proved himself, both in bravery and conduct, the greatest captain of the age.

Carthage had no sooner relieved itself from the pressure of this bloody and expensive war, than it found itself involved in another, which had very nearly proved fatal. The mercenary troops, when they returned to Africa, found that the public treasury was too much exhausted to discharge their arrears of pay. They quickly became clamorous, and committed the greatest disorders in the city. The senate endeavoured to pacify them, by giving a sum of money for their present subsistence, and persuading them to retire to Sicca, promising that when the remainder of the troops arrived from Sicily, all their demands should be satisfied. At Sicca, they quickly became more licentious than ever; and Hanno, one of the Suffetes, was sent to allay their discontents. Upon his arrival at Sicca, he conducted himself in the most preposterous and imprudent manner. He expatiated upon the poverty and distresses of the state; and, instead of answering the high expectations of the discontented, he desired them to be satisfied with receiving part of their pay, and remit the remainder to meet the pressing exigencies of the commonwealth.

The mercenaries were highly exasperated by these disappointments; and still more, when they saw their cause entrusted to Hanno, to whom their merits and services were utterly unknown, while neither Hamilcar, nor any of the officers under whom they had served in Sicily, came forward on the occasion. Immediately they had recourse to arms; and advancing to Tunis, they encamped before it, with a force little short of twenty thousand men. The Carthaginians, greatly alarmed by the approach of such a body of irritated enemies, endeavoured to soothe them with promises and concessions. After much discussion, the mutineers consented to refer their claims to Gisco for decision. He had obtained the affection and confidence of the troops, when left by Hamilcar in command at Lilybæum. Relying on their tried attachment, he set out at once to the camp near Tunis. Having conferred with the several officers apart, and expostulated with them in a firm yet insinuating manner, on their misconduct, he succeeded in persuading them to consent to take their arrears of pay, and return to their allegiance; when on a sudden all his labours were frustrated by the machinations of two miscreants, who had distinguished themselves as leaders in the mutiny. Spondius was a mercenary slave from Rome, and dreaded to fall again into his master's power; and Mathos, who, though an African and free born, had been very active in exciting the rebellion, and was apprehensive of the punishment which awaited him from the Carthaginians. Inflamed by the artifices and misrepresentations of these men, the troops at once rejected all means of conciliation, seized Gisco and his attendants, and loaded them with irons. (*Polyb.* p. 68, 69, 70.)

Carthage was now reduced to a state of the utmost distress; the tributary states of Africa joined themselves to the mutineers; and thus she saw herself surrounded on all sides by active and irritated enemies, and deprived, at the same time, of all her resources and accustomed means of defence. Notwithstanding these adverse circumstances, she did not despond. All citizens capable of bearing arms were mustered, new levies were made wherever soldiers could be procured, and the fleet was refitted with all expedition. The command of the forces was given to Hanno, who at first gained some slight advantages; but was soon after surprised in his camp, and even suffered the mercenaries to possess themselves, without opposition, of the isthmus which connected the city with the main land of Africa. To remedy these disasters, Hamilcar Barcas was once more called to the head of affairs. He marched against the enemy with about 10,000 men, horse and foot, which were all the troops the Carthaginians could at that time assemble for their defence. Having passed the Bagrada by a stratagem, he gave battle to the mercenaries, and completely defeated them, killing six thousand, and making two thousand prisoners. Notwithstanding this defeat, the malcontents had still such advantage of numbers, that their army, under Spondius, and Autonitus a Gaul, were able to surround that of Hamilcar. So completely was this effected, that the whole army must have been destroyed, had it not happened that a young Numidian of rank, by name Naravasus, being struck with admiration for Hamilcar's character and talents, came over to him with two thousand horse. Thus strengthened, he was enabled to give battle on more equal terms. After a most obstinate conflict, in which ten thousand of the mutineers were killed, he remained master of the field. The genius of Hamilcar enabled him to surmount all the difficulties which opposed him. The war continued for three years and four months, and was carried on with extreme cruelty on both sides; such (says Polybius) as had never before been witnessed. Its conclusion was much more fortunate than the Carthaginians could have been warranted to expect; they still retained all Africa in subjection, and revenged themselves on the first instigators of the rebellion, by the infliction of the most cruel tortures. (B. C. 238. *Polybius*, lib. i. *sub fine.*)

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* About half a million sterling. The Euboic talent was sixty Attic minæ, equal to 193*l.* 16*s.* 8*d.*

During the Libyan war, the mercenaries stationed in Sardinia had declared against the Carthaginians, and possessed themselves of all the strong places in the island. The Romans not only gave countenance to this revolt, but actually sent the consul Sempronius with a fleet to support the malcontents. The Carthaginians, being exhausted by their domestic disasters, were obliged to surrender the island without resistance, and to purchase a continuance of the peace by a present of twelve hundred talents.

Hamilcar, by the happy conclusion of the Libyan war, had restored tranquillity to his country; but he found that she would be still unable to cope with her haughty rival. He determined, therefore, to undertake the entire conquest of Spain, in the hope that it would supply to the Carthaginians both a school of military discipline and a magazine of warlike stores, whenever they should renew the contest with Rome. Hamilcar did not attempt to disguise his hatred to the Roman name; he publicly avowed the motives of his expedition, and took with him Hannibal his son, and Hasdrubal his son-in-law, having inspired them both with an implacable aversion against those, whom he considered as the destroyers of his country's grandeur. (*Polyb.* lib. iii. p. 167.) Nine years he fought in Spain, subjecting either by force or by persuasion, the greatest part of the country to the Carthaginian power, and at last fell gloriously in the field of battle at the head of his troops. (*Polyb.* lib. ii. p. 90. *Liv.* lib. xxi. c. 2.) The army elected Hasdrubal to succeed him, which appointment was confirmed by the senate of Carthage. He conducted himself with great prudence; and, to secure the acquisitions of his predecessor, built a city, which was afterwards called New Carthage. (B. C. 227.) The Romans viewed the progress of the Carthaginian arms in Spain with considerable jealousy. For the present, however, they contented themselves with concluding a treaty, the articles of which were, 1st, That the Carthaginians should not pass the Iberus. 2d, That the Saguntum, with the neighbouring Greek colonies which had implored the protection of Rome, should enjoy their ancient rights and privileges. Hasdrubal still pushed on his conquests, though he was cautious not to pass these limits. Having managed the Carthaginian affairs in Spain for eight years, he was at last assassinated by a Gaul, whose master he had put to death. Hasdrubal three years before had written to Carthage, to desire that Hannibal, then twenty-two years of age, might be sent out to him. This was opposed by Hanno, who represented that it would give undue weight to the Barcine party. The objection was over-ruled, and the young soldier was suffered to depart. He quickly drew upon himself the attention of the whole army, who were eager to hail the opening virtues of the son of Hamilcar. Even Livy himself seems, in speaking of Hannibal, to lay aside his animosities as a Roman, and to dwell with delight on the various qualities of this extraordinary man. "Never," says he, "was there a disposition better qualified even for the most opposite things, whether for obedience or for command. Boldly adventurous in undertaking dangers, he displayed eminent skill and presence of mind when engaged in them. No labours could exhaust his body or depress his spirits. He was capable alike of enduring heat and cold, and in his food consulted only the demands of nature, not the suggestions of appetite. No stated hours were allotted by him for sleep or study, either by night or day. It was only the time unoccupied by business that he gave up to repose, courting it neither by silence nor the softness of his bed. On the contrary, he was often seen lying on the ground, amidst the sentinels and guards. He was distinguished from his equals by no superiority of dress, but his arms and his horses were always conspicuous. In the performance of military duties, whether of cavalry or infantry, he was ever foremost: the first in entering the combat, he was the last to quit the field. Eminent as were these virtues, they were equalled by the enormity of his vices. His cruelty was disgraceful to human nature; his treachery without example, even at Carthage; he utterly contemned all truth and sanctity, all fear of the gods, all reverence for oaths, all the obligations of religion." To the latter part of this character the subsequent conduct of Hannibal is in direct contradiction. Much must be allowed to the prejudices of Livy; yet he cannot be acquitted of a malicious intention to blacken, by vague and general censures, the character of the man who unquestionably proved himself the greatest general that has existed in any age.

Such was the man, who now, by the unanimous voice of the army, was called to conduct the affairs of the Carthaginians in Spain He was in his twenty-sixth year, full of confidence and hope. From the first moment of his appointment, he conducted himself as though Italy had been the province allotted to him. After several successful enterprises against the natives of Spain, which served both to secure his previous conquests and to augment his resources; then having, with singular address, furnished himself with all things necessary for the important enterprize, without affording to the Romans a pretext for declaring war, he on a sudden laid siege to Saguntum; and thus, by the infraction of Hasdrubal's treaty, struck the first blow in this eventful war. (B. C. 219.) The train for this tremendous explosion had been laid long before. Polybius mentions three causes, which more immediately led to the second Punic war: the fraudulent and tyrannical conduct of the Romans with respect to Sardinia; the jealousy which was entertained of witnessing the progress of the Carthaginian arms in Spain; and, lastly, that bitter hatred to the Roman name and nation, which Hamilcar had bequeathed to his son Hannibal, and which was in both the predominant feeling influencing the whole conduct of their lives.

Hannibal opened the siege of Saguntum with an army consisting of 120,000 foot, and 20,000 horse. The defence is one of the most memorable in history. The limits of this work do not allow us to enter into the minute details which Livy and Polybius supply. We must be content with stating, that, after a contest of eight months continuance, almost unparalleled for its fierceness and obstinacy, the city was razed, and its inhabitants, without distinction of age or sex, put to the sword, or sold for slaves. The Saguntines had early in the siege dispatched ambassadors to Rome, and deputies were in consequence sent to expostulate against this infraction of the treaty; but Hannibal refused to give them audience. They proceeded, therefore, immediately to Carthage; but found the senate and people little disposed to censure the conduct of their favourite general. After the capture of Saguntum, a formal embassy was sent from Rome, to require a disavowal of the conduct of Hannibal, and satisfaction for the injuries he had inflicted on the Saguntines. Hanno and his friends exerted themselves vigorously to counteract the views of the Barcine party; but in vain. The Roman embassy were not able to effect their purpose of frightening the senate into submission. Upon which, Quintus Fabius, the senior of the ambassadors, held up a fold in the bosom of his robe, and said, "We bring both peace and war; choose ye." He was answered, "We choose that which you like best." "Then be it war," said he, throwing open his robe; and from that both parties prepared themselves for the contest. (*Livy*, lib. xxi. c. 18. *Polyb.* lib. iii. p. 187.)

Hannibal had probably long devised the invasion of Italy, and had convinced himself of the practicability of the attempt. War being now declared, he made his dispositions for the safety of Spain and of Africa, and collected his troops for that great undertaking, the conduct of which had procured for him a reputation superior to all other military commanders. He had well weighed the difficulties of the enterprise, the various dangers of the march, and the uncertainty of procuring supplies: To these were opposed, the advantages which would accrue from carrying the war into the heart of the enemy's country; the assistance he might expect, if he could once reach Italy in force, from those states which were actually in rebellion against the Roman authority, or bore to it only a feigned and uncertain allegiance. Let us not, therefore, magnify the courage of this celebrated warrior at the expense of his judgment, nor suffer the unwarrantable rashness of inexperience to shelter itself behind the great name of Hannibal.

In his march to the Iberus, he experienced no interruption. Thence to the Pyrenees he was obliged to force his way; and apprehending some inconvenience from the leaving an hostile people in his rear, he stationed his brother Hanno, with ten thousand foot and one thousand horse, to observe their motions, and secure the passes of the mountains. During the passage of the Pyrenees, a considerable body of the Spanish allies deserted. Lest this example should prove contagious, he gave out that they had fallen back by his express order, and that he meant to spare a few more troops of the same nation. By these separations, his numbers were reduced from 90,000 to 50,000 foot; he had likewise 9000 horse and 37 elephants. (*Livy*, book xxi. 23. *Polyb.* lib. iii. p. 189, 190.)

After entering Gaul, his march was for some time hindered by the jealousy of the natives; but upon his convincing them he had no object in view besides a mere passage through their territories, he was suffered to proceed without molestation. The river Rhone presented the first serious obstacle. As the Gauls, who inhabited the country contiguous to it, seemed resolved to oppose his passage, he contrived to disperse their forces by a stratagem; but a new difficulty occurred, he had no means of wafting the elephants over this broad and rapid current. The difficulty was at last obviated, by the construction of a sort of flying bridge, by means of which they were all transported in perfect safety. (*Livy*, *Polyb.* ut supra.)

Hannibal crossed the Rhone at Lauriol in Dauphiny.[*] Hence he marched up the left bank of the river, towards the midland parts of Gaul; not because this was the direct road to the Alps, but because he thought the further he advanced from the sea the less likely he was to meet the Romans. Nor was he mistaken; for at the very time he reached the banks of the Rhone, Scipio (the father of Africanus) landed at the mouth of it, and a rencontre actually took place between some detachments of cavalry from the two armies. Brancus, a prince of the Allobroges, having offered to become his guide, he advanced towards the Alps, following the course of the Rhone. Turning to the right,[†] he passed through the country of the Tricastini; from the grand angle of the Rhone at Lyons, to the deep indent which it forms at St Genis. Here he entered Savoy, ranging along the limits of the Vocontian dominions, from this indent to the Sier. Hence he passed through the country of the Tricorii to Geneva, without impediment, crossing the Arve (Druentia) in his march. From Geneva he proceeded to Martigny. Here the hills have an opening to the south 80 paces in width, which, in the days of Hannibal, formed the only channel of communication between Gaul and Italy. The Seduni had occupied this pass; but Hannibal, in the night, seized the heights which commanded it, and obtained possession of their chief city, now St Branchiere. Here the Salassi met him in a friendly manner, and offered to conduct him to Italy by a better road than that he was pursuing. Under their guidance, he turned to the right into the Val de Bagnes, where, in passing a defile, the Salassi fell upon him unawares. The steadiness of his troops saved him from this imminent danger. His infantry got possession of a white rock, (that on which the village of Lultier now stands,) from whence they resisted all the assaults of the enemy. Bewildered by this treachery, he wandered through the Alps for some days, and at last reached the regular road only seven miles from the point at which he had quitted it. It is uncertain by what pass he at last actually reached Italy. Livy does not give any positive opinion. Many circumstances conspire to prove, that it must have been by the Mons Peninus,[‡] (Great St

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[*] The account of Hannibal's route which follows, is given on the authority of Whitaker, whose book (notwithstanding its frequent digressions, and the boldness of its speculations,) eminently deserves to be consulted.

[†] Livy, by an extraordinary mistake, says "ad lævam."

[‡] So called, from a statue or temple of Jupiter Penninus erected on it. In the Celtic, *pen* signifies a *peak*, or *headland*.

Bernard.) Hence he descended to St Remy, having excited the ardour of his troops, by pointing out to them the rich vales of Italy, and the site of Rome itself. At this point the road, which was before steep, had, by a recent subsidence of the earth, been rendered precipitous. The chasm extended across the road to the distance of a thousand feet.[*] It was an even wall of stone, such that even a man on foot could not descend it without difficulty. Hannibal endeavoured to find a path by which he might avoid this ravine, but his horses, elephants, and baggage, sunk in the snow, and he found it impossible to proceed. They rested on the bare ground for the night. The next morning, the Carthaginians employed themselves in felling a number of large trees, and raised a vast pile of fuel on the crags. The trees being of a resinous nature soon flamed, and the rocks appeared glowing beneath them; they then applied vinegar to soften them, and finally opened a path through the burning rocks with their pick axes. This account has been derided by many historians as an incredible fiction, yet, if stripped of the marvellous circumstances which have been added to it by some writers, it contains nothing improbable, nothing which could not have been effected by the ingenuity and indefatigable labour of such a leader, and such an army.[†]

The events of this war are so involved with the affairs of Rome, or rather they form so completely an integral part of the Roman history, that we must refer the reader for its details to that article. The domestic history of Carthage during this eventful period, though it offers but few circumstances worthy of observation, conveys a most important lesson.

In all governments which are in any degree popular, there must be two parties in the state. Those who conduct public affairs, must expect to have their measures scrutinized and thwarted by all who are desirous either of diminishing their influence, or succeeding to the possession of their power. In Carthage, a party such as this (which in modern times we have taught ourselves to call "the opposition") was regularly organized, and its exertions were systematic and incessant. The avowed leader of this party was that Hanno, whose incapacity and misconduct we have more than once had occasion to notice. His constant object was to undermine and destroy the influence which Hannibal, by his talents, success, and family connections, possessed in the state. So violent was his animosity against the Barcine party, that he appears to have disregarded all the real interests of his country, so long as he could cripple their exertions, and mar the execution of their designs. The peculiar fault of the Carthaginian constitution (as we have noticed in the outset) was, that in all cases which produced a difference of opinion, and, on this account, would deserve graver and more mature deliberation, it lost its representative character, and an appeal was directly made to the blindness and party zeal, the narrow conceptions, and infuriated prejudices of the populace. Hanno did not lose sight of the power which this singular anomaly in the constitution afforded him. He availed himself of it on every occasion, and it enabled him to work the destruction of his political opponents; but his country fell with him. The power of Carthage was annihilated on the plains of Zama; and the short remainder of its history contains nothing but a detail of insolent aggressions on the part of its victorious rival. These were met by the Carthaginians on their side by the most unworthy concessions: They gave up their general, they submitted to endure the most unwarrantable interposition of their affairs; in short, they drank the cup of humiliation to its very dregs, in the hope of protracting their existence. But the hope was vain; the haughty spirit of the Roman people could not endure, that a city, which had for a long time resisted the progress of their arms, and even made them tremble in the Capitol, should continue to exist; and the military skill of Scipio Æmilianus was called upon to effect that destruction, which the savage ambition of the elder Cato had resolved upon. The conduct of the Roman people towards the Carthaginians, (as will be shewn when we come to treat of their history,) was stained with cruelty, perjury, and injustice. It was necessary, for the aggrandisement of their city, that Carthage should be destroyed, and they cared little what means were used to accomplish its destruction. This event took place in the year of Rome 608, about 146 years before the commencement of the Christian æra.

Such was the fate of Carthage. Its decay and final destruction ought to be attributed to the intrigues and misconduct of its factious citizens, rather than to the actual power of its rival, however formidable it might appear. The treasure carried off by Æmilianus, even after the city had been delivered up to the soldiers to be plundered, was immense. The destruction was complete; and the senate issued a decree, enjoining, that it should never again be inhabited, and denouncing the most dreadful imprecations against those who should attempt to rebuild any part of it. However, all persons who desired, were admitted to see Carthage; nothing affording to Æmilianus greater pleasure, than to make as it were a triumphal show of the ruins of his country's rival. "Thus," says Paterculus, "does hatred survive the very fear which gave it birth; a rival ceases not to be an object of detestation till it has ceased to exist."

Notwithstanding the denunciations of the senate against all who should attempt to rebuild Carthage, they were induced in a very short period themselves to sanction the undertaking. Twenty-four years after the victory of Æmilianus, (B. C. 142.) the sedition of Tiberius Gracchus began to be formidable to the patricians, since he was supported by the great body of the people, in his endeavours to pass an Agrarian law. Gracchus finding himself unable to accomplish his purpose, was probably not unwilling to accept the offer made him by the senate, of becoming the leader of 6000 citizens to the site of Carthage, for the purpose of its restoration. (*Appian* in fin. lib. Punic.) Gracchus was terrified by prodigies from proceeding in his purpose. It seems probable, however, that a few buildings began to spring up among the ruins; and we have reason to conclude, that, from this time for many centuries, they increased in number, beauty, and convenience. Compared with its former glory, the city was long considered as in ruins. When Marius took refuge there, outcast and deserted, he is said to have dwelt in a hovel amidst the ruins of Carthage; and Sulpicius, addressing Cicero, speaks of it as razed to the foundation. (*Vell. Pater.* lib. ii. c. 19. *Ser. Sul. ad Cic.* lib. iv. p. 5.) Julius Cæsar, too, when in Egypt, in consequence of a dream, in which he beheld a numerous army weeping, determined to rebuild Corinth and Carthage. His death prevented the execution of his purpose. Augustus, finding a record of his intention among his papers, piously fulfilled it, and sent 3000 Romans thither, who were joined by the inhabitants of the neighbouring country. These established a colony adjacent to the ancient city, but not upon the very spot, lest they should be obnoxious to the curse invoked by the senate. (*App.* ubi sup.) Such at least is the account of Appian: yet Strabo speaks of Carthage as the second city in the Roman empire for wealth and power, and he wrote in the reign of Tiberius. This time is scarcely sufficient for so great an advance to be made towards its former magnificence. Perhaps we shall form a just notion of the fact, if we conceive, that Appian has lessened, and Strabo has exaggerated, its importance. Pliny mentions it as a very considerable colony; and it was soon after the commencement of the Christian æra regarded as the metropolis of Africa.

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[*] Whitaker suggests, that "longitudinem" should be read for "altitudinem" in *Liv.*, 21, 36; and the corresponding passage in Polybius tends to support the conjecture.

[†] That fire was commonly applied to divide rocks, may be proved from *Diod Sic.* The effect of the vinegar might have been only to act upon the rock by a sudden change of temperature. "The granites of these parts of the Alps are composed," says Saussure, "of laminated rocks, abounding in quartz and mica. I admired, at St Remy, the very hard rocks, which separate of themselves into tables, perfectly even and perfectly dressed. Their matter is white quartz mixed with yellow mica: and there are thin beds of this mica, the parts of which, having little cohesion, make them to split according to their direction. I measured one which was six feet long and three in breadth, and not more than two inches in thickness." (*Saussure*, iv. 221)

The supply of vinegar cannot be a subject of surprise, since it was the common drink of the soldiery. It was generally called *acetum*, sometimes *porca*. (*Vid.* Lips. in Not. *Mil. Glor. Plauti.* iii. 2, 23.)

The precise period of the introduction of Christianity we are unable to ascertain, but it is evident that it should be fixed very early. For in the middle of the second century, arose Tertullian, the first Latin father of the church with whose writings we are acquainted, and he speaks, as of a notorious fact, of the wide extent of Christianity in Africa. His words are, "Were we disposed to act the part of enemies, should we want forces or numbers? Are there not multitudes of us in every part of the world? It is true we are but of yesterday, and yet we have filled all your towns, cities, islands, castles, camps, courts, palaces, senate, forum:—we leave you only your temples." Gibbon, with his usual unfairness wherever Christianity is the subject, affects to understand an expression of Tertullian (*ad scapulam*) to mean, that a tenth of Carthage alone was converted. That father says, if you would punish the Christians, you must decimate Carthage, that is, you must imitate the Romans when the whole army is equally guilty; you must put to death every tenth man. In the year 311 arose the schism of the Donatists. Cæcilianus had been chosen bishop of Carthage, without the participation of the Numidian bishops in his election; and upon his refusing to submit to their cognizance, they appointed Majorinus in his place. Mutual resentment, and all the bad passions which necessarily mingle in controversy, inflamed the partizans of each faction to the highest pitch of rancour. In 316, Constantine himself heard the cause, and decided in favour of Cæcilianus. The Donatists were supported by a band of ruffians, who called themselves Circumcelliones, and who had recourse to fire and sword as the means of success. Hence all Africa was filled with murder and rapine. Constantine having tried every other method of accommodation, at last had recourse to that which usually has allayed the fury and fanaticism of sectaries, a full permission to the people to follow the tenets of which they approved; but here without effect. And it was only after their defeat at Bagnia by Macarius, the lieutenant of Constans the son of Constantine, that the Donatists were repressed. (*Mosheim*, cent. IV. pt. ii. chap. 5.)

The emperor Julian revived the falling sect, which found a strong and active enemy in St Augustine. The bitter hatred of these schismatics, and the revolt of Count Boniface, governor of Carthage, (A. D. 431.) paved the way for the invasion of Genseric, king of the Vandals. He had landed from Spain at the desire of Boniface, who too late found his error in employing a foreign and barbarous force to do right to an injured subject. He opposed him on his entrance into Africa, and though worsted in several important actions, succeeded in protracting the war for a considerable period. The craft and the perseverance of Genseric finally prevailed; the whole of the fruitful provinces from Tangier to Tripoli were in succession overwhelmed, and Carthage itself was at length surprised, five hundred and eighty-five years after the destruction of the city and republic by the younger Scipio. The stern barbarian carried on the work of desolation in a manner the most systematic and unrelenting. Carthage never recovered the blow; its very name is scarcely to be found in the records of subsequent historians.

Several modern travellers have visited the ruins of Carthage. We shall give extracts from two of them: from Shaw, because he is unquestionably the most learned; and from De Chateaubriand, because his visit was most recent.—Shaw's account is as follows.

"Carthage has not much better supported itself against the encroachments of the north-east wind and the Mejerdah, which together have stopped up its ancient harbour, and made it almost as far distant from the sea as Utica. The place is still called El Mersa, *the port*, lying to the north and north-west of the city, and forms with the lake of Tunis the peninsula upon which Carthage was built. Upon the other side of the peninsula, Carthage hath been a loser by the sea, for in that direction near three furlongs in length, and half a furlong or more in breadth, lieth under water. A little to the northward of these ruins, but to the south-east of El Mersa, are the traces of a Cothon, scarcely a hundred yards square. This was probably the new port which the Carthaginians built after Scipio had blocked up the old; and might be the same that was called Mundracium in the time of Procopius. The greatest part of Carthage hath been erected on three hills, inferior in elevation to those on which Rome was built. Upon that which overlooketh the south-east, there is the area of a spacious room, with several smaller ones by it. Some of them had tesselated pavements, but neither the design nor the materials are worthy of notice. The Byrsa, I presume, had formerly this situation. In rowing along the shore, the common sewers discover themselves; which, being well built at first, time hath not in the least injured or impaired. The cisterns are other structures which have submitted the least to the general ruin of the city. Besides those appertaining to particular houses, there were two sets belonging to the public; the greater whereof, which was the grand reservoir of the aqueduct, lay near the western wall of the city, and consisted of more than twenty contiguous cisterns, each of them about 100 feet long and 30 broad. The lesser is in a higher situation, near the Cothon; having been made to collect the rain-water which fell on the top of it, and upon some adjacent pavements made for that purpose. This might be repaired with little expence; the small earthen pipes through which the rain water was conducted wanting only to be cleaned. Besides these, there are no other tokens left us of the grandeur and magnificence of this ancient city, the rival of Rome: we even meet with no triumphal arch, or sculptured piece of architecture; no granite pillars, or curious entablatures; but the broken walls and structures that remain to this day, are either built in the Gothic manner, or according to that of the later inhabitants."—Shaw's *Travels*, p. 150—154.

The account given by Chateaubriand differs from this in many respects; differences which it would be impossible to reconcile or decide upon, without an actual inspection. We subjoin it in his own words: "The ship in which I left Alexandria having arrived in the port of Tunis, we cast anchor opposite to the ruins of Carthage. I looked at them, but was unable to make out what they could be. I perceived a few Moorish huts, a Mahometan hermitage at the point of a projecting cape, sheep browzing among the ruins; ruins so far from striking, that I could scarcely distinguish them from the ground on which they lay. This was Carthage."—"In order to discover these ruins, it is necessary to go methodically to work. I suppose then, that the reader sets out with me from the fort of Golteltu, standing upon the canal by which the lake of Tunis discharges itself into the sea. Riding along the shore in an east-north-east direction, you come in about half an hour to some salt-pits, which extend towards the west. Passing between these salt-pits and the sea, you begin to discover jetties running out to a considerable distance under water. The sea and the jetties are on your right; on your left you perceive a great quantity of ruins upon eminences of unequal height, and below these ruins is a basin of a circular form and of considerable depth, which formerly communicated with the sea by means of a canal, traces of which are still to be seen. This basin must be, in my opinion, the *Cothon*, or inner port of Carthage. The remains of the immense works discernible in the sea would, in this case, indicate the site of the outer mole. If I am not mistaken, some piles of the dam constructed by Scipio for the purpose of blocking up the port, may still be distinguished. I also observe a second inner canal, which may have been the cut made by the Carthaginians when they opened a new passage for the fleet."

"Having now settled the situation of the ports, the rest will not detain us long. I suppose that we have pursued our way along the coast to the angle from which the promontory of Carthage projects. This cape was never included in the city. Leaving the sea, and striking off to the left, we first find the remains of a very extensive edifice, which seems to have formed part of a palace or of a theatre. Above this edifice, ascending to the west, you come to the beautiful cisterns, which are generally accounted the city relics of ancient Carthage: they were probably supplied with water from an aqueduct, some fragments of which may be seen in the plain. This aqueduct was fifty miles in length, commencing at the springs of Zawan and Zangar. There were temples above these springs. The largest arches of the aqueduct are seventy feet high, and the columns which support these arches are sixteen feet square. The cisterns are prodigious; they form a series of vaults communicating with each other, and are bordered throughout their whole length with a corridor. This is a truly magnificent work. A rugged road leads from the public cisterns to the hill of Byrsa, from the summit of which the eye embraces the ruins of Carthage, which are more numerous than is generally imagined. They resemble those of Sparta, having nothing left in tolerable preservation, but covering an extensive space. I saw them in the month of February; the fig and olive trees already were clothed with their young leaves, large angelicas and acanthuses formed verdant thickets among marble fragments of every colour." See Chateaubriand's *Travels*, vol. ii. p. 285, &c. (J. M. T.)

CARTHAGENA, a sea-port town of Spain, situated in the province of Murcia. It was founded by Asdrubal in the year of Rome 524. It was first called *New* Carthage, being intended by the Carthaginian colonists to rival their African capital: and afterwards it received from the Romans the name of Carthago Spartaria, on account of the great quantity of spart or broom which grows in its vicinity. Anciently it was the principal place of a Roman province, hence called Provincia Carthaginiensis; and the scene of great contention, first between the Romans and Carthaginians, and then between the Romans and Barbarians. In the year 421, it was taken and utterly destroyed by the Vandals; but was entirely rebuilt by Philip II. for the sake of its excellent harbour. The town stands on the declivity of a hill, and is separated from the harbour by a small plain. On the south and the west are high mountains and barren rocks. Towards the north and east it is open, and communicates with an extensive valley, which is of a finely varied surface, has a fertile soil consisting of a sort of red earth, and frequently returning sixty fold, produces different kinds of grain, and abounds in elms, poplars, olives, figs, pomegranates, &c. The streets are spacious, but very few of them are good. The houses are in general flat roofed, and sufficiently commodious. On the top of the hill commanding the city there is a castle, which is rather in a state of decay; and on the adjoining heights there are walls of considerable strength, erected for the defence of the harbour, arsenal, and dock-yard. The public buildings are not remarkable. They are chiefly the *new parade*, which is raised on a regular plan—the *royal hospital*, which is a large establishment, intended for the reception of the sick both in the navy and army—the *cathedral*, which is a miserable pile, and, since the bishop's see was removed to Murcia, has been degraded to the rank of a parish church—the *convents*, none of which deserve particular notice—the *arsenal*, which is a spacious square situated to the south-west of the town, under the mountains, defenceless on the land side, but protected by cannon in its approach from the sea—and the *dock-yards*, consisting of *wet-docks*, where the men of war are moored each of them opposite to the door of its own magazine of stores, and of *dry-docks*, so much infested with water oozing from the marshy soil, that they would never be clear of it, were it not for several fire-engines, which are continually going, and a great pump, which is wrought without intermission by multitudes of Spanish criminals and Barbary slaves. The harbour is the best in Spain, so good, that Andrew Doria, the famous Genoese admiral, was wont to say, he knew but three good ports, and these were June, July, and Carthagena. There is none, indeed, which surpasses it in regularity and safety. It is very spacious, and so deep, that vessels may be moored close to the and; and in one position in it, a large fleet may lie in the utmost security, completely out of the view of all ships that may be at sea, or even in the narrow part of the entrance to the harbour. Its great outline, which is in the figure of a heart, is entirely formed by the hand of nature. On the east and west, high naked mountains rise very steep from the water's edge; and on the north, a low and narrow ridge of hills, on which the city stands, shuts out the view of the inland country. The entrance, which is defended by two redoubts, has the island Escombrera lying off it, in such a way as to shelter it from the violence of the winds and waves. And, indeed, so perfectly is it protected by the high hills which surround it, that from the mole—which is nothing more than a pitiful platform, though protected by twelve pieces of cannon—the entrance of the harbour and basin alone are visible, and even in the time of a storm the water remains calm and unruffled. In the centre of the haven, however, in a line between the mouth and the mole-gate, there is a ledge of rocks, which being only five feet under water, and not indicated by any breakers, is attended with danger to strange ships and careless pilots.

In the immediate vicinity of Carthagena, diamonds, rubies, amethysts, and other precious stones, are said to have been found. It was a long time, indeed, the Indies of the Romans, and there are still silver mines, though it is believed they are nearly exhausted. Rock-crystal also is to be met with both on the east and west sides of the town: and not far off, there are four hot springs, and some traces of an alum mine. At no great distance from the city is a mountain, which furnishes the gypsum used for plaster. Saltpetre abounds throughout the whole country. Carthagena has some extensive vineyards, from which are produced a luscious and thick wine, the best of the kind in that province, and also a sweet wine, which is delicate and agreeable. Only a small quantity of the latter goes into foreign countries, as it is not sufficiently known, though said to be not inferior to the wine of Alicant.—It is chiefly in the neighbourhood of Carthagena that spart or broom is cultivated. Anciently, as Pliny tells us, it furnished the common people with materials for bedding, clothes, shoes, and fire. It is still used for making shoes, ships' cables, and mats for houses, and even a fine thread has been spun from it for the purpose of being weaved into cloth. Although not so much attended to as formerly, it is yet considered of sufficient importance to be an article of exportation, and to be subjected to the operation of duties and monopolies. The fishery here is considerable, and is carried on both within the port and in the open sea. The fishing within the port belongs to a company established by royal charter, while in the open seas all mariners who are enrolled, have a right to pursue that occupation. The fish are of various kinds, the tunny, melvas, &c. A good deal is consumed at home; but the greatest proportion is salted and sent to the foreign market. This branch of industry, as usual, is much discouraged by various injudicious regulations and unfair exactions on the part of government and its inferior officers.—The most important and valuable article of commerce at Carthagena is *barilla*, or potash, the quality of which is excellent, and of which great quantities are annually exported. The plants which yield this substance are all indigenous, and are particularly to be found in a swamp called Almojar, to the eastward of the city. Government, with its accustomed folly, has subjected the barilla to an oppressive tax, which operates very much against the manufacture and exportation of it.—Wool and silk also are articles of commerce.—The chief imports at Carthagena are bale goods and merchandise of various kinds.—There are some excellent schools at Carthagena, for teaching navigation, mathematics, experimental philosophy, drawing, fortification, hydrostatics, &c. but they are instituted for the benefit of pupils for the royal navy, and the public at large have no access to them. There is likewise a botanic garden on a small scale, where lectures are given on botany by a professor of that science.—The most prevalent diseases are intermittent and putrid fevers, occasioned, it is believed, by the proximity of the swamp of Almojar. In the year 1785 and 1786, the city lost by these diseases no fewer than 4800 of its inhabitants.—Carthagena is under a military governor, with his alcalde mayor, thirty regidores, and two syndics. The governor is supreme judge for the army, and for strangers settled in the country. His alcalde presides in the tribunal for the citizens. The office of the regidores goes by inheritance, if not previously sold, and these, with the Escrivanos del' numero, who likewise succeed by inheritance, are constantly intent on plunder, and extremely tyrannical in the exercise of their power. The syndics are chosen by the people; but the election is under the influence of the regidores, and, as it is annual, they dare not attempt any thing in the way of redressing grievances.—Murders and assassinations are frequent in Carthagena, owing to the want of energy in its municipal government. Seldom are the perpetrators of these crimes punished, unless they be miserably poor; for the escrivanos are always ready to protect those who will gratify their rapacity.—The marriage vow is here violated in the most shameless manner. A gentleman one morning said gravely to his friend, "Before I go to rest this night, the whole city will be thrown into confusion." This confusion he actually produced, by going home an hour before his usual time, and surprising his wife's paramour, who in like manner returning suddenly, occasioned the same bustle and retreat at his own house; and this succession of retreats and surprises pervading the whole town, he literally fulfilled his morning's prediction.—Swinburne says, that though there are several regiments here in garrison, besides engineers and naval officers, we can scarcely imagine any thing so dull as the town of Carthagena; and that, with the exception of the wretched comedy and the coffee-house, there is not the least life or amusement going on. Laborde gives a very different account. He tells us that Carthagena is quite unlike the rest of Murcia, as it is distinguished by affability, society, amusements, and pleasures: strangers are well received, and the inhabitants are very hospitable. He adds, however, that there are few Murcians among them, the greatest part of them being foreigners, English, French, and Italian, who are either merchants, sailors, or soldiers.—In this town there are three tolerable inns, which are kept in the French style, and afford good entertainment.—The population is about 60,000, which is distributed among 15,000 houses. East Long. 1° 6′, North Lat. 37° 34′. See *Polybius*, lib. x.; Swinburne's *Travels through Spain*, vol. i. p. 188; Townsend's *Journey through Spain*, vol. iii. p. 121; and De Laborde's *View of Spain*, vol. ii. art. *Murcia*. (*τ*)

CARTHAGENA, a province of South America, in the vice-royalty of New Granada. Its boundaries are the Carribean sea on the north, the river St Martha on the east, Terra Firma on the south, and the sea and gulf of Darien on the west. It is 100 leagues in length, from north-east to south-west, and 80 in width, from east to west. It was discovered in 1520, by Roderigo de Bastidas. The people being of a warlike character, resisted various attempts that were made to conquer them; at length they were subdued in 1533, by the governor, Pedro de Heredia. A great part of this country is composed of mountains and forests; but there are also some very fruitful vallies, which the natives call savannahs, and in these are many settlements of Europeans, Indians, and Spanish Creoles. Towards the north, a part of the territory is swampy, sandy, and from the lowness of the ground full of sea-water pools. The climate is remarkably hot and moist; and from May to December, the weather is almost continually rainy or tempestuous. Accordingly the earth is covered with perpetual verdure, and rice and Indian corn are raised in sufficient quantities for the consumption of the inhabitants. The same circumstances which render the production of these so easy and certain, are unfavourable to the growth of wheat and other grains that are cultivated in Europe. There is a great variety of plants, trees, and fruits. Of trees, the principal for size are, the *caobo* or *acajou*, the wood of which is beautiful, fragrant, and close in the texture, and is employed in making canoes and other small vessels; the *cedar*, which is of two kinds, white and red, the last being the most esteemed; the *maria*, from which the maria oil is obtained; and the *balsam*, which distils the balsam of Tolu, so called from a village where it is found in the greatest abundance, and of the best quality. The fruit trees consist of the tamarind, the medlar, the sapote, the papayo, the guayabo, &c. Of most of these, not only is the fruit palatable and wholesome, but the timber also is finely variegated, and very durable. Pine-apples, limes, melons, grapes, oranges, medlars, dates, papayas, cocos, plantanes, bananas, &c. are in vast abundance. The mançanillo deserves particular notice. It grows to a large size; near the top its branches form a kind of crown; its wood is very hard, of a yellowish cast, and exquisitely veined like marble. Its fruit resembles an apple exactly in shape, flavour, and colour, but contains a very strong and deadly poison. Its white juice has the same quality in such a degree, as to render it unsafe to work the wood until it be thoroughly dried. Even those who happen to take shelter under it in a shower, feel the same effect from the dropping of the leaves as if the juice had fallen upon them. And the very beasts are said to have such an instinctive aversion to it, that they will neither eat of the fruit nor approach the tree. Palm-trees too, of different sorts, grow on the mountains in great numbers, producing various kinds of fruits, and exuding a juice from which, when fermented, a species of wine is made, of a whitish colour, a racy taste, and an intoxicating quality. The guiacum and ebony trees are also very common. The hardness of their wood is almost equal to that of iron. There are numerous plantations of sugar-canes; a great many cotton trees, some of which grow spontaneously, while others are planted and cultivated; and cacoa-trees, which are chiefly found on the river de la Magdaleno, and the fruit of which, both in size and goodness, excels the same kind of fruit in all the other parts of the country, except Soconusca and Caraccas, whose cacoa sells highest at Cadiz. Of the vegetables, which grow here in such profusion and variety, the sensitive plant is one of those most frequently met with. There is also a great quantity of bejucos, one species of which is particularly known on account of its fruit, called the bean of Carthagena. This bean is reckoned the most effectual antidote against the bite of the venomous animals, which are found here in great numbers. The cow and the hog are the only tame eatable quadrupeds to be seen in this district; but these are in great plenty. The flesh of the former is not remarkably good; that of the latter is extremely delicate, and the ordinary food of the inhabitants. The hides and tallow furnished by the cattle, form a considerable article of commerce. Poultry, pigeons, partridges, and geese, are both good and plentiful. Nothing can surpass the variety and beautiful plumage of the birds. Bats appear in great multitudes; and are said to be the most dextrous bleeders both of men and cattle. Deer, wild boars, foxes, armadillos, squirrels, rabbits, and monkies, are extremely numerous. There are also leopards and tigers, which make great havoc among the cattle, and sometimes prove destructive to the inhabitants. Poisonous reptiles abound. The principal ones are snakes, coral-snakes, rattle-snakes, and the culibras de bejuco;—the centipedes, which swarm here, and are monstrously large;—and scorpions, which are equally numerous, and of various kinds.—The principal rivers are the de la Magdalena, already mentioned, and the San Juan, or Atracto, both of which are navigable, and contain alligators, tortoises, and a multitude of fishes.

This province contains two cities, seven towns, and ninety-six settlements or villages. When first discovered, it was well peopled, but since that time the population is considerably diminished. According to the numeration of the *fiscal* of the royal audience of Santa Fé, Don Francisco Moreno y Escandon, there were, in the year 1770, of whites, 59,233; of Indians, 13,993; and of negro and mulatto slaves, 7770. See Juan and Ulloa's *Voyage to South America*, vol. i.; Alcedo's *Geographical Dictionary of America and the West Indies*, *with* Thompson's *Additions*, vol. i.; and Peuchet's *Diction. Univers. de la Geograph. Commerç.* tom. iii. (τ)

CARTHAGENA, the capital of the province just now described, is situated in a large and convenient bay of the same name. It stands upon a sandy peninsula, and communicates with the continent by narrow necks of land and wooden bridges. The city and the suburbs are well laid out. The streets run in straight lines; are wide, uniform, and tolerably well paved. The houses, which are mostly built of stone, have only one story above the ground floor: their apartments are well contrived, and their balconies and lattices are of wood, which, from the nature of the climate, are there preferable to iron for such purposes. The outside of the buildings, on account of the smoky colour of the walls, has a dirty and disagreeable aspect. The fortifications are constructed after the modern manner, lined with freestone, and of considerable strength. Besides a precinct and bastions, there is a half moon, which defends the entrance, or gate; and several castles situated on small eminences, and on the side of the bay. In this place there is a great number of religious communities, who have churches and convents for their accommodation. These are characterised by poverty in their ornaments, though their architecture is appropriate, and their capacity sufficient. The cathedral church is magnificent. There is a college of Jesuits. A tribunal of the Inquisition is also established here, in which respect Carthagena is on a footing with the metropolitan cities of Lima and

Mexico. The power of this tribunal reaches to Isla Espanolo, where it was first settled, Terra Firma, and Santa Fé. Carthagena is the head of a bishopric erected in 1534 by Pope Clement VII. The jurisdiction of the bishop extends as far as that of the civil and military government. The government of the city is managed by a person who resides in it, with the title of governor, having under him a requisite number of civil and military officers. In civil matters, an appeal lies to the audience of Santa Fé, and in military affairs to the viceroy of New Grenada. The police of the city is conducted by a secular magistracy, consisting of regidores, from whom are annually chosen two alcaldes. There is also a revenue office, where all taxes are received, and the necessary payments issued. Processes are determined by a man of the law, with the title of auditor de la gente de guera.—Carthagena, on account of its advantageous situation, and the excellence and safety of its harbour, very soon became the most important settlement and emporium of the Spaniards in South America. So early as the year 1544, it was a town of some commercial celebrity. Being selected as the port in which the galleons should first trade on their arrival from Europe, and to which they were ordered to repair previous to their voyage homeward, the resort to it was so great, and the means of prosperity so copious, that in a short time it rose to be one of the most populous and most opulent cities in America. And though, from the arrangements which have since taken place respecting the galleons, and the general circumstances of the commercial world, it has declined very much, it still carries on a considerable inland and foreign trade, and preserves no small portion of its comparative importance. It is reckoned by Humboldt to stand before all the other ports, with the exception of Vera Cruz, the Havannah, and Lima. Including the small adjoining ports of Rio Hacha, Santa Maria, and Portobello, with which it is connected by the most intimate commercial relations, it exports annually of the produce of native agriculture to the value of 252,000*l.* sterling. The quantities of that produce are as follows: of cotton 3,307.500lb. avoird.—of sugar, 220,500 ditto—of indigo, 22,050 ditto—of Brazil wood, 882,000 ditto—of quinquina of New Grenada, 220,509 ditto—of balsam of Tolu, 2205 ditto—and of ipecacuana, 13,230 ditto. Besides these articles, there is a considerable exportation of the precious metals, which are carried to Old Spain. The value of the importation amounts to 840,000*l.* sterling annually. The articles imported are brandy, wine, oil, almonds, raisins, tobacco, confectionaries, &c.—The bay of Carthagena, on which depends so much of its commercial consequence, extends two leagues and a half from north to south. It has a sufficient depth of water, and good anchorage; and is so well sheltered, that the ships are no more agitated than if they were in a river. There are so many shallows, however, at the entrance, and on some of these there is so very little water, that a skilful pilot is always requisite to steer the vessels into it with safety. The difficulty of navigating vessels in it is also increased, by the irregularity of the tides, which increase the danger of striking, and by the slimy and tenacious consistence of the bottom, which, when a vessel does run aground, renders it often necessary to lighten her, before she can be got off. In this bay there is great plenty and variety of fish, both wholesome and agreeable to the taste. The turtles are large, and of excellent flavour. Sharks are here very common, large, voracious and destructive. There are vast multitudes of craw fish, from which the country on this coast got from the Indians the name of Calamari, signifying the land of craw-fish. All along the coast, salt is produced in great abundance.

The importance and wealth of this place have made it the object of frequent attacks. In 1544, it was taken and pillaged by some French adventurers, under the direction of a Corsican pilot. About forty years afterwards, half of it was laid in ashes by Sir Francis Drake, and the rest was saved from destruction by the neighbouring colonies, who paid for it a ransom of 120,000 silver ducats. It was a third time invaded, in 1597, by the French under the command of M. de Pointis, to whom it capitulated, but whose avarice consigned it to plunder. It was again besieged in 1740, by the English under Admiral Vernon, but it held out successfully, and the besiegers were obliged to retire after a great loss of men and labour.—The inhabitants of Carthagena consist of various casts or tribes: whites, negroes, and Indians, and the different classes produced by the intermarriages of these. They drink brandy in the forenoon, make use of a great deal of chocolate, and are fond of smoking tobacco, which last practice is indulged in equally by both sexes. The fandango is the common amusement. This ball, or dance, which is the ordinary mark of rejoicing on festivals and remarkable days, is conducted with great propriety in houses of distinction; but among the lower orders it is accompanied with hard drinking, indecency, and quarrels. Their funeral ceremonies they observe with great pomp and ostentation, lamenting for the deceased in the most clamorous and frantic manner, and continuing their mourning in the house for nine days after the interment. Their diseases are chiefly the *black vomit*, with which the distemper that attacks Europeans on their first landing frequently terminates; the *leprosy*, to which the people both in town and country are very subject, and for the purpose of stopping which a hospital, called San Lazaro, is erected on the top of a hill in the neighbourhood, where persons of both sexes infected with it are strictly confined; the *cobrilla*, or little snake, so called from the general belief that it is one of those animals which has introduced itself beneath the skin of the patient; and the *spasm*, or *convulsion*, which is very prevalent, seldom comes alone, and always proves mortal. The intense heat and moisture of the climate, naturally lead to the conclusion, that the inhabitants must be unhealthy; yet it is a fact that in general they enjoy good health, and it is not uncommon for them to survive their eightieth year. The profuse perspirations, however, occasioned by the high temperature, render their complexions wan and livid, and all their movements sluggish. The population is said to be between 20,000 and 30,000, of which above 9000 are in communion. West Long. 75° 26′ 45″, North Lat. 10° 26′ 35″. Juan and Ulloa's *Voyage to South America*, by Adams, vol. i.; Humboldt's *Political Essay on New Spain*, vol. iv.; Alcedo's *Geographical Dictionary of America and the West Indies, with* Thompson's *Additions*, vol. i.; and Peuchet's *Diction. Univers. de la Geograph. Commerç.* tom. iii. (τ)

CARTHAMUS, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See Botany, p. 286.

CARTILAGE. See Anatomy, p. 714. 733.

CARTONEMA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 189;

and Brown's *Prodromus Plant. Nov. Holland.* &c. p 271.

CARUM, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 160.

CARYOCAR, a genus of plants of the class Polyandria, and order Tetragynia. See BOTANY, p. 232.

CARYOPHYLLUS, a genus of plants of the class Icosandria, and order Monogynia. See BOTANY, p 232.

CARVER, JONATHAN, a distinguished American traveller, was born at Canterbury, in the state of Connecticut in 1729. He was a descendant of John Carver, Esq. the first governor of the colony of Plymouth in the year 1620. Having lost his father, who held a subordinate station among the officers of the government, when he was only about five years of age, his mother was reduced to the necessity of soliciting public aid in behalf of herself and family. The select men of his native town made ample provision for them, and at a proper age young Carver, after being instructed in the elements of a common school education, was placed under the direction of one Bradford, a shoemaker. In this humble capacity he did not long continue. His active mind and roving disposition were unable to undergo the close confinement to which he was subjected, and the severity of his master adding new force to his passion for adventure, he left him with the determination of indulging his natural propensity for travelling. On the commencement of hostilities between Great Britain and France in 1755, relative to the possession of the rich and extensive country between the Allegany Mountains and the Mississippi, Carver enlisted as a private soldier and proceeded with a body of troops to the defence of the frontiers of New York. At the siege of Fort William Henry in 1757 he was attached to the troops under the command of General Webb, at Fort Edward, and was of the number of those who escaped the dreadful massacre committed by the Indians belonging to the French army, upon the surrendering of that place to the Marquis de Montcalm. In 1758, Carver was promoted to a lieutenancy in Col. Partridge's regiment, and in the following year served in the army of Wolfe at the battle of Quebec. About this time he was honoured with a captain's commission, and as an officer, distinguished himself equally for bravery and talents.

Upon the peace of 1763, Captain Carver resigned his station in the army, and immediately formed the resolution of exploring the vast extent of territory ceded to Great Britain by the treaty of Versailles; a resolution in the highest degree honourable to him, and in the execution of which he fully exemplified the boldness and manliness of his character. He had already become inured to difficulties and dangers, and he was not long in attempting the objects of his pursuit. Having passed some time with his family in Massachusetts, he set out from Boston in June 1766, and in the September ensuing arrived at Fort Michillimackinac, the most interior English post. At this place he made the necessary arrangement for pursuing his travels, and by the influence of Governor Rogers, was furnished with a supply of such goods as might enable him with the greater ease and security to accomplish his intentions. It is unnecessary here to detail any of the events of his journey through a wilderness of which at that time so little was known from actual observation. His interesting narrative has been long before the public. In the accomplishment of his spirited and hazardous undertaking, he must ever be considered as having rendered by his own individual exertions a most important service to his country. Carver returned to Boston in October 1768, after an absence of two years and five months, having travelled during that time nearly seven thousand miles.

He now set about properly arranging his travels, and in 1769 departed with his family for England, with the expectation of publishing the results of his observations, and of receiving a becoming reward for his labours. Here, however, he was treated with the greatest ingratitude. He presented a petition to his majesty in council for a reimbursement of the sums he had expended during his journey: his petition was granted by the board of trade, only, upon the condition of his delivering up his charts and other papers relating to the discoveries he had made. The arrangements which he had formed with the booksellers for the publication of his travels was thus frustrated: he afterwards with much difficulty procured a duplicate copy of his work, which, under the title of *Travels through the Interior Parts of North America, in the years* 1766, 1767, *and* 1768, was printed for his benefit in 1778, in one volume octavo, and dedicated to Sir Joseph Banks, F. R. S. with whom he had long enjoyed an acquaintance. There can be little doubt that the principal, if not the sole reason why Captain Carver was disappointed in the support he expected from the British government for his eminent services, was owing to the peculiar condition of the American colonies and Great Britain. The work of Carver presented a favourable view of the country and its future resources, and it did not accord with the designs of the ministry of that day, to give it sanction or currency. In 1779, was published in folio, the New Universal Traveller, containing an account of all the empires, kingdoms, and states, in the known world. The work was chiefly an historical compilation, and appeared as the production of Carver. What particular hand he had in it is not known. It is asserted by some, that he sold his name to it for a trifling consideration, in order to support his destitute family; certain it is, that shortly after this period he was reduced to the necessity of finding employment as a clerk to a lottery office. In this menial situation he continued until his death, which took place in London, January 31st, 1780, in the fifty-first year of his age.

Carver's book of travels in America is so well known as to supersede the necessity of any particular notice of its merits. His ardent thirst for adventure prompted him to undertake enterprises the most extensive and hazardous, which his indefatigable perseverance enabled him successfully to accomplish. His narrative in general is perspicuous and interesting; though it is to be regretted that through the want of a scientific education, he was not qualified to give a correct and satisfactory account of the numerous objects of natural history which came within his reach. Notwithstanding this circumstance, considerable information may be gathered from his work concerning the properties of many vegetable productions of this country. Volney (View of the United States) admits his sincerity and veracity, though he accuses him of being in some instances credulous, and thinks that his descriptions afford too favourable a picture of the Indian tribes. HOSACK AND FRANCIS.

CARYOTA, a genus of plants of the class Monœcia, and order Polyandria. See Botany, p. 314.

CASAL, a town of France, in the department of Marengo, and formerly the capital of Lower Montferrat, is situated on the right bank of the Po. It received the name of *Casale Sancti Evasii*, after the death of St Evasius, who was martyred by a Duke called Astabolo. It is highly probable that it was built not far from an ancient town called *Sedula*, and not, as some authors have imagined, on the ruins of *Bodincomago* or *Industria;* (see Pliny, *Nat. Hist.* lib. ii.) The few huts which were built by the devotees over the place where the body of the martyr was preserved, gradually assumed the form of a town, while Liutprand, king of the Lombards, built the church which still exists, and which was afterwards erected into a cathedral. In the year 1173, Casal was erected into a free city; and, about the end of the 14th century, it became the residence of its sovereigns. Pope Sextus IV. erected Casal into an episcopal city; and, in spite of the revolt of its inhabitants, the Dukes of Mantua preferred it to Mantua as a place of residence. About this time, when the arts made such a rapid progress in Italy, this city acquired fresh lustre. New palaces and new churches were erected; and many families removed to it from Mantua. While it was in the possession of the French, Catinot, who was the governor, constructed the citidal, which was reckoned one of the strongest in Italy. It was, however, carried away by the Piedmontese and Spanish troops in 1695, and all the fortifications were demolished. There now remains only an old castle, where a small garrison might hold out for some hours.

The principal public buildings in Casal are, the theatre, the seminary, the lyceum, the palaces of M. M. Gozzani St George, Gozzani Odalengo, Vincent Ricci, and Roland Delavalle; and the churches of St Dominique and St Philippe. There is a charming promenade from the Marengo gate to that of the Po. The principal hotels are, the Hotel Mogul, the Trois Rois, and the Nouveau Puits.

Casal is inhabited by several ancient and illustrious families, some of whom pretend to have their descent even from Numa Pompilius. Population 14,000. East Long. 8° 37′, North Lat. 45° 7′. (π)

CASAL Maggiore, the name of a town which is the chief place of a district of the same name in the department of the higher Po, and the kingdom of Italy. It is situated near the Po, and was made a town in 1754. Population 4150.

CASAN. See Kazan.

CASAUBON, Isaac, a very learned critic and editor, was born at Geneva in February 1559. His natural abilities were good, and so great was the progress which he made under the tuition of his father, who had become minister of Crest in Dauphiné, that he was scarcely nine years of age, when he could both write Latin with correctness, and speak it with ease. But his father being under the necessity of going from home on business for three years together, Isaac's education was neglected, and he almost entirely lost what he had acquired. When he reached his twelfth year, he again applied to his studies, and partly by his own exertions, partly by the occasional assistance of his father, he began to recover his classical knowledge. This method, however, being uncertain and tardy, he was sent in 1578 to Geneva, to study under the professors there; and so great was his diligence, and so attentive were his teachers, that he soon redeemed all the time which he had formerly lost. Such was his proficiency in Greek, that Francis Pertus, the Cretan, by whose instructions he had been made acquainted with it, thought him worthy to be his successor in the academical chair at the age of twenty-three; and to that honourable situation, accordingly, he was appointed in 1582. In 1586, his father died, and shortly after he married a daughter of the celebrated printer Henry Stephens, by whom he had twenty children. After holding the professorship of Greek at Geneva for fourteen years, during which time he studied philosophy and civil law, and paid some attention to the Hebrew and the Oriental languages, he removed to Montpelier, as professor of the Greek tongue and polite literature, with a more considerable salary than he enjoyed at Geneva. This change of situation was occasioned, not merely by the difference in his emoluments, but also by the morose temper of his father-in-law, and by his own restless disposition. At Montpelier, he was at first much esteemed, and greatly pleased; and resisted the invitations which were given him, first by the city of Nismes, and afterwards by that of Franeker, to accept of a chair in their universities. But he soon began to be disgusted with the treatment which he received. The promises that had been held out to him were not fulfilled; his salary was neither regularly nor fully paid; and he experienced so much vexation from these and other causes, that he was just on the eve of returning to Geneva, when better prospects were opened up to him in another quarter. By M. de Vicq, a man of some note at Lyons, whom he visited in 1598, he was taken to Paris, and introduced to King Henry IV., President de Harley, President de Thou, (Thuanus,) and other persons of eminence, who gave him a very civil reception. The king offered him a professor's place, and, after his return to Montpelier, renewed the offer by letter.

He at last resolved to go to Paris, though he was warned by M. De Vicq and Scaliger, that his expectations would probably be disappointed. Henry received him most graciously; but the jealousy of the other professors, and his own Protestant principles, were the occasion of much opposition and trouble, and even prevented him ultimately from obtaining the situation which his majesty had promised. He was, however, appointed one of the judges on the Protestant's side at the conference between these and the Catholics, held at Fountainbleau in 1600. And afterwards he was nominated keeper of the king's library, which gave him access to a valuable collection of books, and enabled him to prosecute his literary views with great success. He had also a pension from the king, which was considerably augmented, in order to prevent him from yielding to the many pressing solicitations and pecuniary inducements which he had to go to other places. Many artful and unworthy attempts were made to bring him over to the Romish faith, but these he uniformly resisted, and lived and died a Protestant. The murder of the king, which happened in 1610, distressed him deeply, as it deprived him of his chief patron; and in the same year, the conversion of his eldest son to the Roman Catholic religion, gave another blow to his feelings, and he felt it the more, because it was generally reported, and by many believed, that he himself had contributed to this change. These afflicting circumstances, together with the continual vexations in which he lived at Paris, determined him to set out for England, into which country he had been frequently invited by James I. He arrived there in 1610, and experienced from persons of rank and learning the kindest reception, though he himself has complained, that from the inferior classes of people, he met with more insults than he had even done at Paris in the midst of Papists. The king shewed him particular attention, took much pleasure in conversing with him, admitted him several times to his own table, presented him with a sum of money to enable him to visit Oxford and Cambridge, granted him a pension of three hundred pounds, and nominated him to two prebends, one at Westminster, and the other at Canterbury. Casaubon was not ungrateful; and he seems to have expressed his gratitude in a way most agreeable to the feelings of James, namely, by flattering his literary vanity, and humouring his silly prejudices. In the letters which he wrote, by the direction of James, to De Thou, respecting his history, and which, it is not improbable, were inspected by the royal eye, he eulogizes the king in the most fulsome manner for his learning and his virtue, and actually talks of him as a kind of miracle or prodigy. He also remonstrates with De Thou on that part of his history which affected the character and conduct of the king's mother, and in James's name demands satisfaction for the injuries which he had done to her reputation. This remonstrance produced some effect; and by these and similar compliances with the temper of James, Casaubon contrived at once to make his acknowledgments for past favours, and to lay a foundation for future claims. His object was not lost. So much was his majesty pleased with him, that he wrote to the queen regent of France, through whose indulgence Casaubon had been permitted to come to England, begging her to allow him to prolong his stay in this country, and the royal favour seemed to promise him distinctions and preferment; but a painful distemper soon closed these flattering prospects, and put an end to his life. He died July 1, 1614, in the 55th year of his age, and was buried in Westminster Abbey. His character, religious as well as literary, has been variously represented; but there appears to be good reason for believing, that in both these views he was highly respectable. That he was a Protestant, there can be no reasonable doubt, though the contrary has been insinuated, and though he entertained, along with Grotius and other eminent men, the foolish project of forming an union between the Catholic and reformed churches. The probity and correctness of his moral deportment have never been disputed. Of his extensive learning, he has left a multitude of satisfactory proofs in the various editions of Greek and Latin authors, and other works which he published in the course of his life. A large volume of his *Letters* was published, from which a tolerably correct idea, both of his temper and classical attainments, may be derived. A complete list of his writings is given in the *Biographia Britannica*, art. CASAUBON. Besides that article, and the *Letters* above mentioned, (Almeloveen's Edition, containing a life of Casaubon) see Niceron, *Memoirs pour serv. à l'hist. des Hom. Illust.* tom. xviii; and *La Vie de M. de Thou*, in Durand's *Hist.* du xvi. Siecle tom. vii. (τ)

CASBIN, CASVIN, or CASWIN, supposed to be the ancient *Arsacia*, a city of Persia, in the province of Irakajami, situated in an extensive plain of the same name, surrounded with mountains at some miles distance. Casbin, which is now a complete mass of ruins, was formerly about six miles in circumference, and contained 12,000 houses, and 100,000 inhabitants; but, in consequence of the civil wars with which the country has been agitated, it has been greatly reduced both in magnitude and opulence. Its walls and palaces are completely destroyed, and it is at present defended neither by forts nor garrisons. An earthquake, according to Morier, within no distant period, threw down the buildings which were in the Tottie, and made cracks in almost every wall. A large mosque, erected by the Abbasses, has been in many places rent in its thick walls, and totally ruined. The Royal Piazze, or Hippodrone, was no less than 700 paces long, and 250 broad. The Khan is a very large building. The Bason is remarkable for its agreeable construction; and the principal mosque is well built.

The following interesting account of Casbin is given by Hanway, which we are obliged to present to our readers in his own words, as we have no means of ascertaining whether or not the buildings which he describes are now in existence.

"The houses are, for the most part, below the surface of the earth, as are many of the gardens joining to them, to obtain the conveniency of water, which is brought to them from a considerable distance in channels; for, as we usually bring water up to our houses, they level their houses to the water, which, however, are not the less agreeable in hot weather. They are generally built with sun-dried bricks, and their cement is a strong lime. The roofs are flat; so that it is easy and familiar to sleep on the house tops. These buildings are enclosed with a mud wall: they consist of two divisions; the outer stands in a large area, and consists of a spacious room, one side of which is open, and supported with pillars. In these they dispatch their business, and also eat, when they do not retire to the women's apartment. There are niches in the wall, which answer the purpose of tables: the floors are covered with large worsted carpets; and on the sides of the room are felts, about a yard broad, and are generally two or three yards long. These are called *næmets*, as already mentioned: and are made either with wool or camel's hair; and, being very thick and soft, are used for sitting upon. In the wings of this apartment there are smaller rooms for lodging. In the same yard there are apartments for the servants, and also their stables. On the back part of this building is another, likewise enclosed by a wall, which, for the sake of privacy, is generally entered by two turnings. Here is the women's apartment, into which no man is suffered to enter, except the master of it.

I then went to see the new palace which Nadir Shah had built in this city, adjoining the old one. The entrance of it is formed by an avenue of lofty trees, near three hundred yards long, and fifteen or twenty broad. The wall round it is about an English mile and a half in circumference; it is thick and lofty, having only one entrance, which is an arched gate. The top of this gate projects, and is formed into many small squares. Within are four large squares, with lofty trees, fountains, and running water, which makes the place awful and majestic. The apartments are raised about six feet from the ground. The Aivan, or open hall, is in the centre, and shuts with folding doors. The rooms are ornamented in an Indian taste, and the ceilings formed into small squares, embellished with writings of moral sentences in very legible characters. Most of the windows are of thick coloured glass, made transparent, and painted with such art, and in such proper shades, that the glass seems cut into the several figures it is designed to represent. Many of the floors are only of hard earth; others of a composition of beaten stone. The seeming defect in this instance is made up by the constant use of carpets.

The Haram is magnificent, consisting of a square within its own wall of brick, about thirty feet high, and two and a half thick. There are four distinct apartments, in some of which are fountains, which serve to moderate the heat of the summer, by giving the air a refreshing coolness. The rooms are lined with stucco, painted in the Indian taste, with birds and flowers of different magnitudes; the colours beautiful, and set off with gilt edgings. These apartments have small chimney-pieces, in a mean taste; and some are ornamented with looking-glasses in small squares, of many different dimensions, set into the walls. There are some few rooms below ground, admirably contrived for coolness. Near the Haram is the eunuchs' apartment, remarkable only for its having but one door, and that a very strong one. The brick of which the whole of the modern building is made, appears to be ill prepared for duration. Here are also some old apartments built by Shah Abas, yet standing, in which are some bad pieces of European figures by European painters. The Persians themselves are as ignorant of shades as the Chinese. The apartment where the Shah kept his Casbin treasury, I was not permitted to see,—not even the place where it stood. They said he had above twenty millions of crowns there, of which part was in large ingots of gold, run into cavities of the earth, the better to secure it from being plundered."

Both at Casbin and at Herot, the blades of sabres are fabricated from the steel of the country. A kind of tapestry, of a most expensive kind, is manufactured here from pieces of cloth of various colours. Stuffs of silk and cotton are likewise manufactured in this place. All kinds of arms, but particularly fire-arms, fine cloths, watches, and engraved stones, are among the principal objects of commerce in this city. Rubies, granites, and turquoise stones, find a ready market in Casbin. The latter, which are called *Firasc*, are found in great quantities near Nisabur and Firus-cah, of the size of a pea; and those which are as large as a small bean are sold for 20 or 30 sols.

Casbin is admirably situated for connecting the commerce of Hyrcania, Iberia, and Media, with the southern provinces of Persia. It is the great mart for the silks of Guilan and Chyrvan; and there is brought to it a part of the rice of Guilan and Mazanderan.

The fields and gardens in the neighbourhood of Casbin produce great quantities of vines, which yield the finest grapes in Persia; and almonds, pistachios, and melons, are raised with great success. "This place," says M. Morier, "labours under great inconvenience from the want of water: indeed, through the whole extent of the immense plain that we traversed during the day, there was not one natural stream, but many *kanauts* were making; and wherever there is irrigation there is fertility, and the cultivation is rich. Upon the whole, therefore, our route from Teheran displayed a country of much more promising appearance than we might have expected in Persia."

Within the space of twenty leagues round Teheran, the King alone goes in a litter; and even his children have not this privilege. General Gardanne was obliged to quit his; and his brother, who was wounded by a blow from a horse, could with difficulty obtain an exception from this rule.

The river Kulma passes at some distance from this city. In the time of Hanway, Casbin contained only 1100 houses. Olivier makes the population from 20,000 to 25,000; but, according to the author of the *Journal d'un Voyage*, en 1807 and 1808, it is now inhabited by about 60,000 souls. East Long. 49° 33′, North Lat. 36° 15′. See Chardin's *Travels through Persia*; Hanway's *Account of the British Trade over the Caspian Sea, with a Journal of Travels through Russia into Persia*, vol. i. p. 153, &c.; Olivier's *Voyage dans Perse*, Paris, 1807; *Journal d'un Voyage, dans la Turquie, d'Asie, et la Perse, fait en* 1807 *and* 1808, p. 44—46, Paris, 1809; and Morier's *Journey through Persia, Armenia, and Asia Minor, to Constantinople, in the years* 1808 *and* 1809, p. 253, London, 1812. (π)

CASE. See GRAMMAR.

CASEARIA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 208.

CASERTA, a city of Naples, in the country of Lavora, situated at the bottom of a lofty range of hills, and celebrated chiefly for the magnificent palace erected by Charles III. of Spain, from the designs of Vanvitelli.

The palace of Caserta, which is situated in a plain near the site of the ancient Capua, is an oblong square, 787 feet in length, and 616 in width. The two principal fronts contain five stories, with 37 windows each, while the other sides contain five stories, with 27 windows in each. It is divided by intermediate ranges into four courts. In the centre is an open vestibule, with a staircase 60 feet by 90, which leads by double flights into an octagonal saloon, 90 feet in diameter, which is divided by eight marble columns into a circle, and surrounding gallery. On one side is a long row of antichambers, leading into halls of audience, presence chambers, and state bed-rooms, with numbers of cabinets, wardrobes, and waiting rooms. On another side is a range of private apartments, adapted to domestic convenience, and on a third side is the splendid chapel, incrusted with pannels of yellow marble, and not inferior in size or decoration to that of Versailles. Antique columns of alabaster support the roof of the theatre, and divide the house into 42 boxes. The gardens, which correspond in magnificence to the palace, are very extensive, and are formed with wide alleys, and with crowded rows of statues.

The aqueduct, which is 27 Italian miles and 218 palms long, conveys the rivulets of the Appennines into the reservoirs of Caserta. The aqueduct, properly so called, is two miles long, and consists of three stories of arcades, of which the upper one is divided into 43 arches, while the lower one contains a smaller number. It is paved with calcareous stone from the neighbouring mountains, and the rest of it is built with volcanic tufa. In the construction of the aqueduct, an ancient tomb was found at the depth of 90 feet. The expence of building the palace and aqueduct amounted to seven millions of crowns. "Caserta," says a modern traveller, who visited it in 1802, "is not yet finished, and probably never will be, though it has been in hand for half a century, as the situation is so flat as to be incapable of modern decoration, and his present majesty takes more pleasure in the present mansion house of Saint Leucio, where he amuses himself with superintending a manufactory of silks and gauzes." See Spallanzani's *Travels*; Swinburne's *Travels*; Reichard's *Guide des Voyageurs*, &c. tom. i. p. 478; *Travels from Paris through Switzerland and Italy*, *by a native of Pennsylvania, in* 1801 *and* 1802, letter 23, and *Encyclopædia Methodique*, art. AQUEDUC. (*o*)

CASHAN, KASHAN, or CACHAN, a town of Persia, in the province of Irak-ajemi, situated in the plain of Cashan, which is bounded with the distant range of mountains, of which Demawend formed the most conspicuous and the highest point. This mountain is distinctly seen at the distance of 150 miles, and the Persians maintain that it can be seen at Ispahan from the minaret of Mesjid Shah, which is 240 miles distant. It is of a conical shape, and rises abruptly from a long and unbroken range. This town, which was founded by the wife of the Caliph Haroun-el-Raschid, is fully a league long from east to west, and more than half a league from north to south. The houses are built of earth and brick. The principal public buildings in Cashan are the bazars and baths, the royal inn, the royal palace, and another palace for ambassadors, and about forty mosques and three grand sepulchral monuments in honour of three descendants of Ali. M. Olivier, who lately visited this city, remarks, that it is the largest, the finest, the richest, and the most populous that he saw in Persia. It had almost entirely escaped the disasters of the civil wars; and though nearly a fifth part of the houses were destroyed, yet the mosques, the caravanseras, the bazars, and the royal palaces, (which were singularly beautiful,) were all in a good condition. Cashan was once famous for its potteries, and has various manufactories of silk and cotton stuffs, brocades, and all sorts of copper utensils. The inhabitants work a great deal in gold, silver, and steel. Sabres and poignards are also made to a considerable extent. The surrounding country produces abundance of rice, cotton, tobacco, wheat, barley, and fruits of all kinds. They cultivate also the ricinus, from which they extract their oil for burning. The vine is common, and raisins and dried apricots form a considerable article of commerce. The population of Cashan under the Sophis, was 55,000, but at present it does not exceed 30,000. Chardin makes the number of houses 6500. East Long. 51° 21′, and North Lat. 33° 59′. See Chardin's *Travels;* Morier's *Travels through Persia, Armenia, and Asia Minor*, p. 177, 231, 241; and Olivier's *Voyage in Perse.* Paris 1807. (*o*)

CASHEL, a city of Ireland, in the county of Tipperary, situated about three miles to the east of the river Suire. This town, which was formerly the residence of the kings of Munster, was once encircled with a wall, which is in a state of decay, but there are still two gates of tolerable workmanship. The principal ornaments of this town are seated upon the celebrated rock of Cashel, which commands a most extensive prospect. One of these is the old Gothic cathedral, the nave and choir of which is about 200 feet long from east to west. The ruins of Cormac's Chapel, which stands beside the cathedral, and differs from it completely in its stile of architecture, are about 50 feet long by 18. A high round tower is also situated upon the rock near the eastern angle of the north aisle. It is 54 feet in circuit, and is divided into five stories, with holes for rafters, and is built of freestone, while all the other buildings on the rock are of limestone. A wall formerly inclosed the whole of the rock.

The principal modern edifices in Cashel, which is tolerably built, are a market-house, a house in which the sessions are held, a county hospital, barrack, and a charter school. The church is neatly built, and the archiepiscopal palace is a simple and commodious building. Cashel contains about 600 houses, and therefore nearly 3000 inhabitants. West Long. 7° 5′, North Lat. 52° 30½′. See Campbell's *Philosophical Survey;* Ledwich's *Antiquities;* and Wakefield's *Statistical and Political Account of Ireland.* (*j*)

CASHGAR. See Rennel's *Memoir*, p. 197, and BUCHARIA, LITTLE.

CASHMERE, CACHEMIRE, or KASHMIRE, a province of Hindostan, and formerly subject to the king of Candahar. It is situated between 33° 18′ and 34° 15′ North Latitude, and between 73° 30′ and 75° 12′ East Longitude. It is only a valley of an elliptical form, surrounded by hills, which in its largest extent from south-east to north-west is hardly 80 miles; its greatest breadth may be from 40 to 50. Towards the north and north-east, this district of country is bounded by what, in these parts, are termed the mountains of Thibet; a branch probably of that immense range which, rising near the Black Sea, penetrates through Armenia, and skirting the south shore of the Caspian, extends by way of the north-eastern provinces of Persia to Thibet and China. On the east it is bounded by the river Chunaub; on the south-east and south by the territory of Jummoo and Kishtewar; on the south-west and west by the territory of the Ghickers, Prounce, Muzzufferabad, and some other independent districts. In a north-eastern direction from this province lies Great Thibet. Little Thibet is to the north-west of it. Southward are the provinces of Lahore and Cabul: and to the west Great, and to the north Little Bucharia. In the Ayeen Acberry, Cashmere is divided into two parts, viz. Meraje and Kamraje; the former being the eastern part, and containing the districts situated to the east, the south-east, and the north-east of Sirinagur, which is the principal town of the province; and the latter the western part, containing the north-west and south-west districts. On the south-east of Sirinagur, at some distance beyond the great circle of mountains that surrounds the valley of Cashmere, is the district of Bannaul, which, though a fertile vale of ten or twelve miles in length, and dependent on the Cashmerian territory, is yet suffered by the governors of that province to remain uncultivated, that it may not afford shelter or provision to the bordering Hindoo states, which, in former periods, have through this tract approached the interior passes of Cashmere. In as far as a place may be secured against foreign attack by means of its natural boundaries, there are few tracts of country to which such defence has been more liberally afforded than it has been to Cashmere. It is, in fact, so completely inclosed within the lofty mountains that separate India from Great Tartary, that it is only by climbing over rocks of an immense height that it can be entered on any side. Surrounded thus by mountains, whose summits are, during a great part of the year, covered with snow, it is moreover elevated considerably above the level of the adjacent low grounds to the south. Hence it is that the air of this district is colder than its latitude would lead us to expect; and even within the space of little more than two degrees there is found an almost complete change in the vegetable productions, few of these of any kind being in this country the same with those of more southern India, and of the fruits of the latter region hardly any being to be traced here, except the mulberry.

The valley or country of Cashmere, thus situated, is yet celebrated through Upper Asia, and indeed gene rally has been in high reputation wherever it has been known, for its romantic beauties, the fertility of its soil, the temperature of its atmosphere, and a picturesque variety of landscape. The author of the *Ayeen Acberry* dwells with rapture on the beauties of this province, and the ideas which have been entertained of it may, in some degree, be understood from the epithets by which it has been so commonly characterised: the happy valley,—the garden in perpetual spring,—the paradise of India. The periodical rains which almost deluge the rest of India are shut out of Cashmere by the height of the mountains, so that only light showers fall there, but these are in sufficient abundance to feed thousands of cascades, which are precipitated into the valley from every part of the stupendous and romantic bulwark by which this favoured spot is encircled. At the foot of that exterior chain there is an inner circle of hills abundantly clothed with grass, trees, and various sorts of vegetation, and frequented by numerous animals, both in a wild and in a tame state. The soil of the plains is every where the richest that can be conceived. Indeed, it is considered to have been composed of the mud deposited by the principal river of the district, which flowing in this direction, and finding no outlet, at first formed its waters into a lake that covered the whole valley, but eventually having opened for itself a passage through the mountains, left this spot so fertilized, an ample field for human industry and for the accommodation of a happy race. The circumstances which indicate that to have been the mode of its formation, appear to have been such as to have satisfied a very competent judge. Although this account, says Major Rennel, has no living testimony to support it, yet history and tradition, and what is yet stronger, appearances have impressed a conviction of its truth on the minds of all who have visited the scene, and contemplated the different parts of it. It is indeed, he remarks, a mere natural effect, and such, he conceives, must be the economy of nature in all cases, when water is inclosed in any part of its course by elevated lands. If the lake be formed near the sources of the river, and the ground is solid, no doubt such a lake may remain for an indefinite length of time, or for ever, in the same state, for want of sufficient force in the river to work out a passage for itself; but when the lake has been formed in the lower parts of a river, even the most apparently insuperable obstacles will, in consequence of the great accession of water, and consequently of strength, in such circumstances be forced at last to give way. This is exemplified, not singly in the instance of the river of Cashmere. In the same manner the Euphrates has been found to open a passage for itself through Mount Taurus, the Ganges through the Imaus. The length of time which the lake in Cashmere seems to have occupied in effecting its emancipation, is evinced by the great depth of soil deposited by it previously to its departure.

The river of this place alluded to, which continues to pass through the province, is still, even within its limits, large, and navigable at least for small craft. Its current, throughout the whole valley, is remarkably smooth—a proof of the uncommon flatness of the country, as the body of water contained in it is very great. Its breadth is irregular: in some places it is not less than two miles. In one part of its course it is formed, by the hollow surface of the country, into a sheet of water, of seven or eight miles in circumference, known by the name of the Ouller or Wuller. The outlet through which it departs from the valley, and where it runs with much greater rapidity and force than elsewhere, is at Barchmooleh, between two steep mountains, whence proceeding, it, after a long course, joins with the Chunaub. In this river, now known by the name of the Behut or the Chelum, we recognise the famous Hydaspes of antiquity, which Alexander the Great passed over, about 100 miles below the limits of the valley.

As the surface of this district is generally flat, and it is copiously watered, it yields abundant crops of rice, which is the common food of the inhabitants. At the base of the surrounding hills, where the land is higher, there are cultivated wheat, barley, and various other descriptions of grain. Hemp and saffron are also common productions, and iron of an excellent quality is found in the adjacent mountains. A great number of nuts for dyeing are raised here. A wine is made in the country resembling Madeira; also a spirituous liquor is distilled from the grape. The vegetable productions of Cashmere, moreover, are not such only as are subservient to mere unadorned use. The plane-tree, the species of it termed the *platanus orientalis*, which, though common in most parts of Asia, is said to arrive at greater perfection here than in other countries, has, when in full foliage, a grand and beautiful appearance, and in hot weather it affords a refreshing shade. Still more deserving of notice, in this view, is the rose of Cashmere, the season of the first appearance of which is hailed with so much delight by the natives, and of which the essential oil or ottar is held in universal estimation. In all directions in this province, there occur the European plants, flowers, and fruit and other trees; and in the gardens there is abundance of melons, skirrets, beets, radishes, with all the variety of our pot-herbs. The pasture-grounds of Cashmere are plentifully stocked with the useful domestic animals, as cows, sheep, and goats. There is a kind of sheep here called Hundoo, which is used to carry burthens. There are also gazels and musks. Game abounds in the country, and there is a plentiful and productive stock of bees. Indeed the whole of this favoured district may be said to resemble a garden, interspersed with towns and villages, which rise amongst green meadows, beautiful trees, and all the variety of other vegetable productions; watered by numerous streams and rivulets, which, flowing in all directions from the surrounding rising grounds, hasten to convey their tribute to the Behut or Chelum, the parent of the soil; intersected by canals, which wind through it in every variety of form; still farther diversified by lakes, in some of which are observed floating islands; and cheered, enriched, and enlivened by all the varied aspects of active and animated nature. Still one dreadful evil of a physical kind is here experienced. This is the frequent recurrence of earthquakes, to secure themselves against the fatal effects of which, the inhabitants commonly build all their houses of wood, of which an abundant supply is to be obtained from the neighbouring mountains.

The Cashmerians are considered to be the most ingenious of all the nations of India. With as much taste for poetry and capacity for science as the Persians, they are more industrious and more laborious. They fabricate the best writing paper of the East, which was formerly an article of extensive traffic, as were also its lacker-ware, cutlery, and sugars. Their elegant works in wood, are in request in all the surrounding districts of country, and they are deservedly admired for their address and expertness in the arts of varnishing, veneer-ing, and gilding. But the most noted and the most important of all the artificial productions of Cashmere, consists in its shawls, which, with good reason apparently, have attained a celebrity hitherto unrivalled. It has been alleged that the wool of which one description of these shawls is made, is not found in the country, but is brought from Thibet. It has also been pretty commonly understood that those of another kind are made of goats' hair. Both of these notions seem to be founded in mistake. The breed of sheep, whence the wool in question is obtained, though not peculiar to this country, is at least common to it with Thibet and Boutan, and the shawls which have been considered to be formed from goats' hair, are the produce of the wool of the camel.

The same circumstances which constitute Cashmere one of the finest regions of the earth, contribute also not a little to the beauty of its flocks and the superiority of its wool; its pure air and constantly serene sky, brilliant nights, continual dews, innumerable springs which water the hills and the plains, and the union within itself from its particular situation, in respect to vegetable produce, of the advantages of all climates. Particularly, the mountains which surround this rich and fertile district yield abundance of aromatic plants, that afford excellent pasture for sheep; they are covered almost the whole year with wild thyme and sweet marjoram. By a due care on their own part, added to these advantages, for which they are indebted to nature, the Cashmerians obtain in favour of their manufactures that to which chiefly they owe their excellence, the finest wool in the world. The sheep from which this wool is procured, is one of the most beautiful of its species: its mean length is from 36 to 40 inches, its height from 20 to 22, and its weight from 55 to 60 pounds. The most distinguishing characters of this race, are a small head and lively eyes; their front is not rough, and they have a long and wrinkled dewlap. The lambs are brought forth with crispy wool on the flanks, but they have only a few flocks on the back and along the spine. Each sheep produces at an average about three sers, of thirty ounces, of clean wool. It is a valuable and essential quality of these sheep, essential at least in such a district of country as that to which they are confined, that they can bear the extremes either of heat or cold. Yet to secure them against the injurious effects that might possibly ensue from their exposure to the greater heats of the summer season, they are, during the continuance of these, made to traverse a lake or a river several times a day. In Cashmere, moreover, as in Greece and in Spain, the sheep are moved from place to place within the limits of the province, (a range, narrow indeed as to extent, but very considerable in respect to variety of climate), that throughout the whole course of the year they may be kept nearly in an equal temperature. At the same time, they are never, with a view to this object, crowded into cots or confined places, which, it is justly apprehended, would be in every respect only injurious to them. By such management, at once the health of the flock is preserved, and the wool is whitened and becomes of a texture soft and silky. Without any farther care, besides that of preferring always a lamb of the second birth for a breeding ram, avoiding to cross the breed, providing a little nourishment for the sustenance of the animals at those seasons, when they are not suffered to range abroad, or when little is to be found for them in the fields, and meeting, with a few simple remedies, any incipient or apprehended disease, the Cashmerians obtain that extraordinarily fine white silky wool, which generally, from the nape of the neck to the flanks, is from 20 to 22 inches in length, and even on the flanks and lower parts of the body, is not less than five or six, and equally of that length, which, in short, both for fineness and for whiteness, surpasses every other wool, even the most celebrated for those qualities throughout the known world.

The general practice in Cashmere is to shear the sheep only once in the year, the operation taking place 15 or 20 days after the return of the great heats, when, from the perspiration of the animals, the wool may have become more soft and pliant. During the period of the shearing, the sheep are washed commonly twice a day, or oftener, but as well for the safety of the animals, as to guard against crisping or hardness in the wool, only at those times in the morning or in the afternoon when some degree of diminution has taken place in the strength of the sun's rays. It is indeed an estimable and peculiar quality of the Cashmerian wool, that it has no hard coarse part; a quality the more deserving of notice, as it is not possessed in common with it even by the wool of the Spanish sheep.

The Cashmerian wool, exclusive of the fleeces of lambs under two years of age, which are set apart for certain inferior purposes, is divided into the arouel, or the wool of the young sheep, and the duaume, which is the name given to that of the old. The first of these kinds is a little shorter than the other; it is obtained from sheep between the age of three years, when the shearing of what, in the language of the country, is called the touss, begins, and that of seven or eight. The duaume is longer than the arouel, a little less greasy, weaker, and less silky. These two kinds of wool are each subdivided into two sorts, that of the back and that of the belly. The wool of the belly is used only for the manufacture of a particular stuff, that is consumed in the country and the neighbouring provinces. The finer parts of the wool having been first exposed to the vapour of a slight ley, formed from the ashes of the leaves of the banana tree, or of a clayey barren and white earth, which by the Indians is called ole, then washed with the farina of a small cylindric bean, called moungue, known in botany by the name of mango, and lastly rinsed repeatedly in pure water, are employed, as they are of the one or the other of the descriptions above named, either in the manufacture of shawls, or of those pieces of cloth which have retained the name of the country, and which it has been so often attempted, but commonly with such indifferent success, to imitate in Europe.

The common fine shawls manufactured in Europe are the white: in the preparation of others, the yarn of the wool is previously stained with such colours as may be judged the best suited for sale. These shawls have flowered corners, and a border of greater or less breadth, according to the price. The border, which usually displays a variety of figures and colours, is attached to the shawls after fabrication, but in so nice a manner that the junction is not discernible. The texture of these shawls resembles that of the shalloon of Europe, to which it has probably communicated the name. They are usually made 3½ ells in length, and half an ell in breadth. The price at the loom of an ordinary shawl is eight rupees; thence in proportion to quality they produce from 15 to 20; even 40 are sometimes paid for very fine pieces; and by the introduction of a great deal of flower-work, the value, or rather the price, may be increased even to 100 rupees. The superfine shawls are those that are made of the wool of the camel. This wool, which is more beautiful than that of Vigonia, is extremely scarce, being found only on the forehead and around the ears of that animal. It is dear in proportion to its scarceness, so that the shawls formed from this material, besides costing, even at the manufactory, the sum of ten guineas, are at that price with difficulty to be procured. Shawls, the weft of which is camel's wool, are distinguished by the name of *cacacheti;* the white, with the weft of sheep's wool, are called *seaumi;* and the rest are known by the appellation of *passari.* The superior softness and beauty of the shawls of Cashmere, comparatively even with those formed from similar materials in the neighbouring provinces, is attributed by Bernier to something in the water of the country. They have a very extensive sale over all the Western and Southern Asia; and, agreeably to the remark of Volney, which seems as if intended to indicate the variety of the circumstances in which they are to be met with, they make a part of the dress of the Egyptian Mamelukes, and they are worn by English ladies. The Cashmerian pieces of cloth are more than sixty French ells in length, and rather beyond one-half ell in breadth. The price at the manufactories amounts only to the moderate sum of 15d. These cloths are far superior to the imitations of them either in England or in France, and they last much longer; a superiority to be attributed no doubt to the better quality of the wool.

The articles of manufacture which have been just mentioned, form the great object of the trade and industry of the Cashmerians. All, even to their children, are employed in them. In former periods, when the country enjoyed, in a greater degree than it afterwards did, the advantage of a good government, the province is said to have contained 40,000 shawl looms. At present, they are not considered to be more than 16,000.

There are still seen here merchants and commercial agents of most of the principal cities of northern India; also of Tartary, Persia, and Turkey; but owing to the heavy oppression of the government, and the rapacity of the bordering states, which prey upon the foreign traders, and often plunder whole cargoes, the commerce of Cashmere has fallen, for some time, rather into a declining and languishing state.

Intersected as it is with numerous streams, navigable for small vessels, great advantage and conveniency might arise to this country, especially in respect to its interior commerce, from the water conveyance; but in this, as in other instances, the miserable policy of the Afghan government, has been at once at variance with its own interests, and the prosperity and happiness of the people.

Cashmere seems, at one period, to have been subject to the Turkish dominion. This is indicated by the name by which it has been formerly known, that of Turchind, or the India of the Turks. Previously to the Mahometan conquest of India, this province was celebrated for the learning of its Bramins, and the magnificent construction of its temple. The æra of its subjection to the Mahometans appears not to be very precisely ascertained; but it is probable that a country containing a valuable commerce, and a profusion of natural beauties, would at an early date attract notice, and invite their conquest. It was governed in long succession by a race of Tartar princes of the Chug or Chugatay tribe, until the year 1586, when it was subdued by Acbar, more it is said through the aid of internal treachery, than by the force of his own arms. It remained annexed to the house of Timur for the space of 160 years, after which it was betrayed by the Mogul governor to Ahmed Shah Duranny, who formed it into a province of the Afghan empire. In this situation it is commonly placed under the authority of an individual deputy, commissioned by the sovereign, on the personal character of which individual, of course, a great deal will depend, as to the extent, at any time, both of its freedom and its happiness. The measure of either of these, at a late period, when the country was visited by European travellers, appears to have been far from being considerable.

The annual public revenue of Cashmere has differed at different periods, influenced no doubt by causes, which during the same times influenced, in one way or another, the general prosperity of the district, and the welfare of its inhabitants. In the time of Aureng-zebe, only about 35,000*l.* a year were derived from it. During Shah Ivan's reign, the revenue of this province was no more than 25,000*l.*; and it was only 20,000*l.* in the time of Mahomed Shah. More recently, a revenue of between 20 and 30 lacks of rupees has been collected from it, of which a tribute of seven lacks is remitted to the treasury of the reigning prince. Unfortunately, in the case of a country circumstanced as this is in respect to government, the amount of the revenue actually obtained from it at any time, is no adequate criterion of the measure, at the same time, of its prosperity. It appears that the great increase of revenue, which in later periods has been drawn from Cashmere, has been forced from it only by means of the most rigorous and oppressive extortion.

The military force of this district consists of about 3000 horse and foot, chiefly Afghans: the natives of the country are systematically excluded from it. From some examples that have been noticed, it would appear that these troops are very poorly, as well as irregularly, found in pay, insomuch as, upon occasions, to have been obliged to pick up, as they best could, a scanty subsistence from the spontaneous productions of the country.

The language of Cashmere is, by some writers, considered to be peculiar, and of very ancient date: others hold that it is derived from the Sanscrit. It resembles in sound that of the Mahrattas, but with more harshness; on which account, probably, it is that the inhabitants of this country have been accustomed to compose their songs in the Persic language, or have adopted those of the Persian poets. Notwithstanding the rugged character of their own speech, it is said that a taste for music is universal amongst all classes of the people of this province.

The Cashmerians are supposed to have a religion of their own, different from that of the Hindoos. Abul Fazil says, that the most respectable people of that country are the Reyshees, who, though they do not suffer themselves to be fettered by traditions, are doubtless true worshippers of God. It appeared to some who had travelled in those parts, that the inhabitants generally were extremely lax, in regard to matters of a religious kind, being ready to adopt any system, or none, as might best suit their particular interests, or as might be recommended to them by prevalent fashion. Yet, every where here, there occur the evidences of the force of superstition; the places of worship dedicated to Mahadeo, to Bishen, and to Brama, abounding throughout this sequestered spot, and great respect being paid to miraculous fountains, or other things or places esteemed holy.

Numbers of hermits have been observed in this quarter, who occupy places nearly inaccessible, and are highly venerated, some of them being supposed to have the power of exciting the fury of the elements, or to possess other supernatural or miraculous endowments.

The population of Cashmere is stated to be, in proportion to its extent, very considerable. The plains abound with inhabitants, as also, where they will admit of it, the declivities of the hills. The Cashmerians are stout, well formed, and as the natives of a country that lies so much within the range of the greater heats of the sun, may be considered a fair people. They have been praised, but apparently without adequate ground, for the fineness of their features, and for countenances rather European than of Tartarian aspect. Certainly these advantages are more subject to question, at least, than that which has been attributed to them in respect to the colour of their complexion. On the contrary, it would appear that the features, even of their females, are ordinarily broad, and that there prevails among them a coarseness of figure.

The dress of the people of Cashmere consists of a large turban, a great woollen vest with wide sleeves, (under which people of the higher class wear a pirahun, or shirt, and drawers,) and a sash, wrapped in many folds round the middle. The women of the higher class are never seen abroad, so that little can be said relative to their dress, but the external, and often only garment worn by those of the inferior orders, is of cotton, and shaped like a long loose shirt. Their principal, or only ornaments—an article in which indeed they do not much indulge—are introduced in the manner of dressing their hair. This people are generally gay and lively, and much addicted to pleasure, which inclination, though somewhat blunted, has not been wholly eradicated in them, even under the rigours of the Afghan government.

The prevailing character of the Cashmerians has been drawn by one who, at no very distant period, visited that country, in lineaments little honourable to them. He never knew, he says, a national body of men more impregnated with the principles of vice than the natives of Cashmere. He represents them as eager in the pursuit of wealth, ambitious in seeking aggrandisement, indifferent as to the means by which those objects of their desire may be attained; arrogant, on the one hand, and rapacious, and on the other ingenious in devising and multiplying modes of luxurious expence; deceitful and treacherous; with the cruelty of cowards; fickle in friendship, and implacable in enmity. In short, it would appear that the numerous train of despicable vices, usually called forth and kept alive in a state of slavery, are here exhibited in frightful deformity; and a land that nature formed for a terrestrial paradise, is, through the depravity of the inhabitants, converted into a scene which, instead of any of the more grateful sentiments of the human mind, is calculated only to excite a heart-felt pity, or a most mortifying and painful detestation. See *Dictionnaire de la Geog. commerçante, par* J. Peuchet; Bernier's *Travels;* Thevenot's *Travels;* Rennel's *Memoir;* Forster's *Journey*, &c.; *Memoir on the Wool and Sheep of Cashmere and Boutan*, by Alex. le Goux de Flaix, in the *Philosoph. Magaz.* vol. xviii.; and Pennant's Indian *Zoology*. (K)

CASHMERE, Cachemire, or Cashmir, the capital of the above province, called also Sirinagur, and sometimes Nagaz, is situated in N. Lat. 34° 12′, and E. Long. 73° 45′. Rennel places it in N. Lat. 33° 49′, E. Long. 73° 11′. This city has been supposed, but there is reason to believe, incorrectly, to be the same that is mentioned by Herodotus, under the name of Caspira, or Caspirus. That opinion has been sanctioned by D'Anville. Dr John Reinhold Forster, on the contrary, conceives the old Caspirus not to have been Cashmere, but a city lying nearer to Persia, perhaps Ghazna, or Ghazmin. (See Bartolomeo's *Voyage to the East Indies.*) It extends on both sides of the river Chelum for about the space of [illegible] miles, and the different parts of it thus disjoined are in some degree connected by four or five wooden bridges, which are here thrown over the river. The houses in this city are slightly built of brick and mortar, with which there is intermixed a large proportion of timber work. Many of them are two or three, some even four or more stories high. The usual manner in which the different parts of these houses are appropriated is this: the lower floor is occupied by the cattle, the second is inhabited by the family, and the third, and those above, are used as warehouses. On a standing roof of wood, there is laid a covering of fine earth, by means of which a defence is formed for them that is equally useful in every season. During the winter, it shelters the buildings from the great quantity of snow that falls at that period, and communicates an agreeable warmth. In the summer, it yields a refreshing coolness; and the tops of the houses being at the same time planted with a variety of flowers, exhibit at a distance the spacious view of a beautifully chequered parterre. This city enjoys many natural advantages. Besides that of a river, which flows through its centre, it is blessed with a mild salubrious air. There is a lake also which extends from the north-east quarter of the city, in an oval circumference of five or six miles, and which joins the Chelum by a narrow channel near the suburbs. This lake has been long noted for its beauties, and the pleasure which it affords to the inhabitants of the country. The citizens frequently go upon it in boats, having, many of them, for this purpose a communication by little canals even between it and their own houses. They here enjoy the sport of pursuing the cranes or other birds which frequent the lake. Taken in connection with the adjacent and neighbouring grounds, the scene which is at the same time presented by it to their eyes, is at once rich in pleasing natural prospects, and exhibits the remains of many striking works of art. Towards the east, the Tucht Suliman, and the Hirney Purvet, form the two sides of what may be called a grand portal to the lake These are two hills, of which the one is sacred to the great King Solomon, who is revered in Cashmere as he who cleared this favoured valley of its excess of water: on the other, Muckdoom Saheb is honoured, to whom, on every important occasion, persons of all descriptions, and of both sexes, present their earnest, and often, it is said, successful vows. The northern view of the lake is terminated, at the distance of twelve miles, by a detached range of mountains which slope from the centre to each angle, and from the base of which a spacious plain, preserved in constant verdure by numerous streams, extends with an easy declivity to the margin of the water. In the centre of the plain, as it approaches to the lake, there is a spacious garden, which appears to have been constructed by Shah Jehan, one of the Delhi emperors, during the period that this district was in the possession of the Moguls. This garden is abundantly stored with fruit trees and other flowering shrubs.

Some of the rivulets which intersect the plain are led into a canal at the back of the garden, and flowing through its centre, or occasionally thrown into a variety of water works, form one of the chief beauties of the place. It is farther decorated by various elegant and commodious pieces of architecture, in the erection and distribution of which, the Mogul princes of India have displayed equally taste and magnificence. These buildings are said to have derived some of their ornaments from the spoils of a Hindoo temple. The other sides of the lake are occupied by gardens of an inferior description, two of which, however, that are the property of the government, the Baugh Nusseem, lying on the north-west, and Baugh Nishat, on the south-east quarter of the Shalimar, are deserving of notice for their larger size and their agreeable appearance. The scene is farther ornamented by the numerous small islands which emerge from the waters of the lake. To the east of this pleasing spot, is the wreck of a fortified palace, erected by Amir Khan, a Persian, when governor of Cashmere. He used to pass much of his time in this residence, which was curiously adapted to the enjoyment of the various species of Asiatic luxury; but the materials of which it was built had been so unsubstantial, that within the space of not more than eight years from the period when it was erected, it could no longer with safety be inhabited. The environs of the town, in general, to the east and the west, are laid out in private gardens, which skirting the banks of the Chelum, or supplied with canals from the lake, afford to the inhabitants various pleasant retreats, and the several little hills that border upon the water, are decorated with villas, mosques, and pagodas, which, intermingled with trees and other forms of beautiful vegetation, present a prospect at once grateful to the eye, and highly pleasing to the imagination.

Many of the houses in the city of Cashmere are large and commodious. No buildings, however, occur, particularly worthy of remark. The Cashmerians, indeed, boast much of a wooden mosque, called the Jumah Mussid;* but its claim to distinction appears to be very moderate. The subahdar, or governor of the district, resides here in a fortress, known by the name of Shere Ghur, occupying the south-east quarter of the city, where most of his officers and troops are also quartered. The streets of this city are commonly narrow and confined, and choked with the filth of the inhabitants, who are proverbially unclean. Thus it is that natural advantages are frequently counterbalanced, or, as may be said, annihilated, through inattention or carelessness of turning them to a proper account. One conveniency that is observed here, is deserving of notice, viz. those covered floating baths which are ranged along the sides of the river, and which must be so much wanted in a country and among a people where the climate and the religion alike concur to render necessary frequent ablutions. See Thevenot's *Travels*, Rennel's *Memoir*, Forster's *Journey*, and Pennant's *Indian Zoology*. (K)

CASHNA. See Kassina.

CASHOO. See Materia Medica.

CASIMIR. See Poland.

CASOS. See Casso.

CASPIAN SEA,

A detached sea, or large lake of salt water in Asia. It is bounded towards the north by the Russian province of Astracan and the Caucasus; and on the south, east, and west, by different provinces of Persia. It extends in length from north to south about 680 miles. It is no where more than 260 miles in breadth, varying between that and its smallest breadth of about 100 miles. It is situated in latitude between 37° and 47° north, in longitude between about 50° and 56° east. Its superficial contents have been estimated at somewhat above 36,000 square English miles. This sea has at different periods, and among different nations, been known by different names. By the ancient Greeks, it was distinguished by the appellation of the Hyrcanian, *i. e.* the Persian Sea. By the Tartars it is denominated Akdinghis, or the White Sea. By the Georgians, it is termed the Kurtshenskian Sea; and the Persians call it by the name of Gursen, from the old Persian capital Gurgan, which is said to have stood in the province of Astrabad, only seven versts from the sea.

We find the Caspian Sea noticed at a very early period by ancient writers. Herodotus, who lived in the 5th century A. C., mentions it in his works, and gives such a description of it as corresponds pretty nearly to what we know of its present state, particularly adverting to the circumstance of its having no apparent outlet, nor any visible connection with any of the great seas. "The Caspian," says he, "is a sea by itself, unconnected with any other. Its length is as much as a vessel can sail with oars in fifteen days, and its greatest breadth as much as it can sail in eight days. It is bounded, he adds, on the west by the Caucasus, and on the east by an immense plain, which extends beyond the reach of the eye." Aristotle describes it in a manner similar to this, and with his usual precision contends, that it ought to be called a great lake, not a sea. With these writers also concurs Diodorus Siculus. But others of the ancient writers, and these commonly too of rather later date than those who have been named, have expressed themselves with respect to this sea in such a manner as would indicate, on their part, a more imperfect knowledge of it than had at periods so much earlier been attained. Strabo speaks of the Caspian as a bay that communicates with the great northern ocean, from which it issues at first by a narrow strait, and then expands into a sea, extending in breadth 500 stadia. With him Pomponius Mela agrees, and describes the strait by which the Caspian is connected with the ocean, as considerable in length, and in breadth so narrow that it had the appearance of a river. Pliny gives a similar description of it. In the age of Justinian, this opinion concerning the communication of the Caspian Sea with the ocean, was still prevalent. Some early writers, among whom is Quintus Curtius, seem to have considered the Caspian Sea to be connected with the Euxine. Arrian also, who, from his residence for some time in the province of Cappadocia as governor, might certainly have obtained more accurate information, declares in one place, that the origin of the Caspian Sea was still unknown, and expresses a doubt whether it was connected with the Euxine, or with the great eastern ocean which surrounds India. Ptolemy maintains its communication with the Euxine, but this by a subterraneous passage, conceiving it to be impossible, without some supposition of this sort, to account for the flowing of so many rivers into it, while on the one hand, there is no appearance of any channel out from it, nor on the other any perceptible swelling of its water, except in the spring, when it is obviously occasioned only by the melting of the snow at that season. Indeed it has in all ages been found a problem of great difficulty to furnish any tolerable solution of the phenomena connected with the sea in question, both in respect to the circumstance just alluded to, and also as it appears in the character of a large sheet of water, possessing the distinguishing properties of sea-water, but dissevered and insulated completely, so far, at least, as is perceptible to any human eye, from all connection with the other portions of that widely extended fluid. The waters of the Volga, the Yacik, the Yemba, the Kur or Cyrus, the Araxes, the Bystraia, the Aksa, the Koisa, the Terek, with many others generally of considerable, some of them rivers of very great, magnitude, run into the Caspian Sea. What, it is reasonable to inquire, becomes of all this water, which certainly cannot be evaporated by the sun alone so fast as it contributes to the enlargement of the body of this sea, and for which, however, there is no other apparent means of escape? And how, moreover, is it that we meet here, in an inland country, and even in the midst of deserts, with a sea detached from all others, yet possessing the same properties, and yielding similar productions? Perhaps the notion of a subterraneous passage is one, which, amidst these difficulties, would occur as naturally, and which really might seem to offer as plausible a solution of them as any other. It has accordingly been strenuously asserted, both in ancient and in modern times, and various arguments have been adduced in support of it. Two of these are as follows: The Caspian, it has been observed, rises very high with a westerly wind, whereas the Euxine, on the contrary, rages most when the wind is at east. It has hence been inferred, that the east wind favours the exit of the waters of the Caspian, and the west wind impedes it. It has, in the second place, been alleged, that there is a whirlpool in a particular part of this sea, by which all its superfluous water is, with a tremendous noise, discharged into the Euxine; and it has been asserted, that near to the mouth of the vortex, there is found a species of sea-weed, which grows only on the shores of the Caspian; that a sort of fish peculiar to the Euxine has been observed in the Caspian sea, near to the place of the supposed vortex; and lastly, that in former days, a fish was taken in that sea with a golden ring about its tail, on which was this inscription, "*Mithridates mihi dabat in urbe Sinope libertatem et hoc donum.*" But as to the first of these arguments, it is to be observed, that the connection attempted to be traced between the character and effects of particular winds, and a subterraneous communication between the Euxine and the Caspian seas, does not seem to rest upon any satisfactory grounds. In fact, it is known that all winds that bring with them humid vapours, are more stormy than those which proceed from arid regions; and this circumstance is plainly sufficient, without any reference to causes, the existence of which is unknown, to account for the greater agitation produced in the Caspian by winds coming towards it in the direction of the Euxine and the Palus Mæotis, than is caused by the eastern winds, which, in their approach to it, pass over a great extent only of dry, and even parched land. Of the whirlpool alluded to, it is enough to say, that we find no notice taken of it in the latest accounts which we have relative to those parts. Sea-weed grows every where along the shores of this sea; but we know nothing of any particular description of this kind of plants which grows only there.[*] We would require also more particular information as to the fishes that are said to be found only in the Caspian and the Euxine seas. The story which Kircher, in his *Mundus Subterraneus*, introduces respecting the fish with the ring, is unworthy of notice.

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* This is the appellation by which the principal place of prayer in Mahometan cities is usually distinguished.

It has likewise been conceived, that the concealed communication is between the Caspian sea and the Gulf of Persia; and in proof of this it has been alleged, that there were every year seen floating on the water in the vicinity of Ormus, a great quantity of willow leaves, of which kind of tree, those who make the remark say, that a great abundance grows in the environs of the Caspian, but none in the interior of Persia. The Tigris, however, it is known, receives a great number of rivers from the quarter of Curdistan and the frontiers of Media, in which places this tree is sufficiently frequent. It occurs also about Bagdad, and perhaps also in the more southern part of Persia. And, were they supposed to be conveyed by the Diala, or the little Zarb, these leaves would have a shorter course towards the place of their destination than that which is assigned to them.

The phenomena of the Caspian Sea have likewise been ascribed to the quality of the bottom, which consists not of a thick slime, but of a shell sand, the particles of which, touching only in few points, render it very porous. The whole shore nearly is formed of a similar substance, which, layer upon layer, lies here to the depth of three fathoms. Through this sand, it has been alleged that the water is filtered, and falls into the abyss beneath in the same quantity which flows into the sea. In the bay of Emba, it is added, above the river Yaik, the water is not let through, the consequence of which is, that it stagnates in that particular part of the lake, even the fishes putrefying, and the exhalations being extremely noxious.

It has been observed, that the districts extending in different directions from the Caspian are sandy and saline, and present the same shells that are found in the channel of that sea, but which, at the same time, are of a very different character from those met with in the beds of the rivers, that did formerly, or do now, run in those parts. Sea salt also occurs in the same tracts, in beds of great depth, and in such quantity as to prevent all vegetation, besides that of marine plants. Salt marshes are another distinguishing feature in this quarter; and, generally, from the appearance of the ground here, the small degree of its elevation, and the nature of the substances which either form the constituent parts of the prevalent soil, or present themselves in a more occasional manner in or upon it, there seems reason to infer, that that sea at one period reached beyond the limits within which it is at present contained. The conclusion to which we are naturally led by these appearances, coincides, at the same time, with the results of certain historical notices which have been transmitted to us, as well as with what we know of the determination of ancient geographers respecting the position and the boundaries of this sea. Thus Ptolemy, it is known, gave to it an extent of 23½ degrees, from west to east, and made it advance 3° more to the north than it does at present; and, in the Byzantine historians, we find mention made of an extensive marsh, that even in the fifth century occupied a large portion of the tract of ground which lies to the north of Caucasus, and between the Caspian sea on the one hand, on the other the Euxine. Hence it appears probable, that in remote times, long prior to the era of our most ancient historical details, the Caspian Sea extended, in a north-west direction, beyond the Mantysch and the Sarpa; towards the north, over all the plains that are watered by the Volga, the Yaik, and the Emba; that it was united to the lake of Aral; and that it covered a part of the plains of Great Tartary. These suppositions being admitted, it may, in connection with them, be allowed, that in the time of Ptolemy the Caspian Sea had an extent somewhat greater than it has at present, though certainly not so great as that which is assigned to it by this geographer; for it was now separated from the lake of Aral, and had long ceased to have any communication with the sea of Azof. With even the latter of these seas, however, as has been already remarked, some indications of its early junction are still to be found in ancient authors, who both assign to the sea of Azof a greater extent than it now has, and take notice of marshes and lakes to the eastward of it, which have been gradually disappearing, but of which the traces are not even yet entirely lost, and of the origin of which no more plausible account can be given, than that they are the remains of one uniform sheet of water, which at a former period covered all the district of country, of which, as its vestiges and remembrancers, these now occupy such detached portions.[*]

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[*] Amongst the sea-weed of this quarter there occurs in some parts a great profusion of the plants proper for the manufacture of soda, an object which might be attended to here with much advantage. Pallas's *Travels*, vol. i. p 293.

Notwithstanding the early attention which this sea seems to have received, it does not yet appear, that any of the ancient authors that have been named, or others who have left any statements relative to it, succeeded in determining even nearly its true form and extent. It was not apparently even ascertained, whether its greatest length was from north to south, or from east to west. So much, indeed, was this point misunderstood, that, in the ancient maps which illustrate the geography of Ptolemy, it is delineated as if its greatest length extended from east to west. In modern times, the first considerable information obtained in Europe concerning the true form of the Caspian, was furnished by Anthony Jenkinson, an English merchant, who, with a caravan from Russia, travelled along a considerable part of its coast in the year 1588. The accuracy of his description was confirmed by an actual survey of that sea, made by order of Peter the Great, A. D. 1718, when it was found to be in length about 1100 versts from the mouth of the Ural to the coast of Mazanderan: its greatest width, from the mouth of the Terek to the extremity of the bay of Mertvoi Kultyuk, being 8°, rather more than 700 versts; and the measurement in other situations more to the southward varying with the position: in one place it was found to be 6°, or somewhat more than 525 versts; in another it was 2° 35′, or 225 versts. The circumference of the sea, comprehending the great gulfs, but excluding the little sinuosities, is stated at 4180 versts. Whatever may be, in other respects, concluded concerning the ancient limits of the Caspian, it will at least hardly admit of doubt, that the chain of mountains which branches from the west of the Ural to the north of Orenburg, and reaches to the Volga, must in all ages have restricted it towards the north. In an eastern direction, the elevated level which now presents itself between this sea and the Aral, may have taken its rise from the quantity of sand rolled down by the Gihon, the Sirr, and other rivers that still flow into the latter sea.

Of the coasts of the Caspian as they now stand, the following is a very brief and general delineation. Towards the north, from the river Terek, in a westerly direction, as far as the eastern extremity of the bay of Mertvoi Kultyuk, the shores are low, flat, swampy, and overgrown with reeds; the water, too, is shallow, and the air, being generally hazy, it may be difficult often for those who have occasion to navigate this part of the sea, to distinguish clearly the places, by which, as a sort of landmarks, it would be useful for them to direct their progress. On the other shores, from the Terek to the desert of Korgan, near Astrabad, and from the northern part of the bay of Balkan to that of Mertvoi Kultyuk, the country generally is mountainous, the shores bold, and the water very deep; so much so, indeed, that even in the vicinity of the shore a line of 450 fathoms will not reach to the bottom.

The ports of the Caspian Sea may be divided into the Russian, the Persian, and the Tartar ports. The Russian are, 1. Astracan, (a full account of which has already been given under that word.) The principal of the commodities that are forwarded from Astracan to the ports of the Caspian Sea, are Dutch, French, Silesian, and English cloths, vitriol, soap, alum, sugar, Russian leather and linens, needles, velvet, glass ware, paper, a few furs, hides, a little tea, corn, butter, wine, brandy, wooden vessels for household uses, sea-horse teeth, iron, copper, tin, lead, iron-ware, clocks, indigo, cochineal, looking-glasses, and cotton stuffs. The most considerable articles of its importation, are silk, chiefly in a raw state, from Shirvan and Ghilan, lamb skins from Bucharia, rice, dried fruits, coffee, wine, spices, saffron, drugs, a little salt, sulphur, and naphtha. The Indians, and the merchants of Khiva, bring to it, occasionally, also gold and silver in ingots and bars, gold dust, precious stones, and pearls.[†]—The second of the Russian ports is Gurief, which is situated at the exit of the Ural, and near to a bay which occurs in that part of the Caspian. There is here a strong fortress, by which the frontiers of the empire are guarded in the direction of the territory of the Kirguese Tartars. There are in the town scarcely 100 houses. Besides the garrison, almost the only inhabitants are a few Armenian merchants from Astracan, who resort to this place for the convenience of trading with the neighbouring Tartars.—The last port worthy of notice belonging to the Russians, is Kitzliar, situated at the mouth of the Terek. There is here also a fortress, which covers the frontiers of the empire towards Persia. The ships bound for this place, used formerly to go quite up to it by the southern branch of the river, but as its mouths have been choked up with sand, goods are now commonly landed in a little bay at a considerable distance from the town. There are brought hither from Astracan, the European commodities wanted for the Persian trade, also corn and other necessaries of life for the Russian colonies on the Terek, and for the inhabitants of the neighbouring chain of the mountains of Caucasus. Besides those branches of legitimate traffic, there is moreover carried on by some of the inhabitants of this place, a smuggling trade to Shamachie, Derbent, and even as far as Teflis in Georgia.

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[*] Professor Pallas considers the actual junction between the Caspian and the Euxine Seas to have been formed by a strait, which communicated on each side with the anciently extended limits of those seas. "It is very probable," says he, "nay almost beyond a doubt, that the low countries of Ulagan, Ternik, Alabuga, and Byeloc, are the old bed of the strait, which, agreeably to the hypothesis advanced in the third part of my former journey, united the Caspian Sea with that of Azof. Even at this day the Caspian Sea, when swelled by tempests, easily overflows the extensive low countries before mentioned. The sand hills which at present separate these low countries from the Manytsh, manifestly originate from the sand banks thrown up by the Caspian Sea, and which are carried by the wind into the steppe; or, perhaps, they were in some degree formed by the sand that remained in the strait itself, as they occupy only a small tract between the two vallies. These sands have also choked up the passage at the mouth of the large river Kuma, which formerly had a free current into the Caspian Sea, by the gulf of the same name." Pallas's *Travels through the Southern Provinces of the Russian Empire, in the years* 1793 *and* 1794, vol. i. p. 296.; see also p. 302.

[†] In 1775, the value of the cloth sent from this port to those of the Caspian amounted to *52,600l.* the cochineal to *15,600l.*, and the indigo to *7000l.* The amount of the imports, in raw and manufactured silks, chiefly the former, is stated at *43,800l.*

The Persian havens are, 1. Derbent, in the province of Shirvan. Owing to the rocks and shoals that prevail in this quarter, vessels can rarely approach the shore, but are obliged to lie at anchor 2 or 3 miles off. On this account, not more than 3 or 4 Russian ships come annually to this place, which are usually laden with oats and rye, bringing with them likewise iron, steel, and lead, for the Lesghees, and other Tartarean nations dwelling on the eastern chain of the Caucasus. There is here a fortress surrounded by high brick walls. The inhabitants are chiefly Persians, Tartars, and a few Armenians. A little corn is produced in the neighbourhood, but not in sufficient quantity to answer to the consumption. It is asserted, that a peculiar sort of grass grows between this place and Terek, on which all the quadrupeds feed with avidity, and that to the horse alone the eating of it is fatal. The town of Derbent lays claim to a high antiquity, a part of it, as is alleged, having been built by Alexander the Great.—2. Niescovaia Pristan, or Nizebad, in the same province, is a port that was formerly much frequented by the Russians. The merchants, particularly from Shamachie, come hither in great numbers with European commodities, to supply the surrounding country. Near to the harbour there are several wretched villages.—3. Baku is reckoned the safest, if not indeed the only proper harbour of the Caspian. Ships may lie here at anchor in seven fathoms water. In some places, however, the entrance is dangerous, on account of shallows, islands, and sand-banks. The fortress is of a similar construction with that of Derbent. The inhabitants of this place are Persians, Tartars, and a few Armenian merchants. The trade here is not considerable, and chiefly centres in the neighbouring districts. The principal articles of export by which its traffic is supported, are the naphtha and the fine rock salt, both of which are obtained from mines on the east of the bay. Saffron and cotton are cultivated by the inhabitants, but not with any considerable advantage. It is supplied with raw silk and silk stuffs from Shamachie, an inland town, and the capital of this province of Shirvan, which is situated from Baku, one also of its towns, at the distance of only 66 miles. It was to the silk trade that Shamachie owed its former commercial importance, and by the same means it is still preserved from ruin, though its traffic has been greatly reduced, in consequence of the exorbitant exactions of the khans of Kuba, and, in the same proportion, the numbers of its inhabitants diminished, and the manufactures of the place even within a short time have greatly degenerated. Baku is usually the residence of a Russian consul.—4. Einzellee, though the most frequented by the Persian trading vessels of all the ports of this sea, is yet but a most wretched place. An entrance into its bay was formerly found through a particular channel which communicated with the sea, but that passage having been obstructed by an accumulation of sand, the vessels which now come hither must remain at anchor in the road. Einzellee, situated on the south west coast of the Caspian, consists of an old and new town, the former inhabited by Persians, and the Armenians subject to the jurisdiction of the sophi; the other by Russian merchants, and such Armenians as acknowledge the authority of the Russian government. A Russian consul resides here, who has under him a garrison of 30 soldiers; and the Russians trade to this port to great advantage. It is happy in its position, as it lies in the province of Ghilan, the district the most noted for those articles, which have always been chiefly in request with the traders who have engaged in the commerce of these parts, viz. silk, and silk stuffs. Commodities go from hence to Reshd, through which a supply of European goods is thus furnished to the bordering provinces of Persia, and the neighbouring independant states as far as Georgia. The remaining part of the supply for those more northern states is derived immediately from Astracan, through Kitzliar and Mosdok. A portion is also sent from Shamachie, for the use of the Lesghee Tartars, and other independent tribes in that vicinity. In the town of Einzellee, there are churches belonging to the Russians and the Armenians, and about 300 houses, formed mostly of reed. It is the refuse only of the Persian and European commodities that is sold here. The great mart in this quarter is Reshd, where there is a concourse of merchants from Tauris, and the principal cities of Persia, Armenia, and Turkey, for the purchase of these, and of the raw silk and the manufactures of Ghilan. Here, accordingly, the Russians dispose very advantageously of their European commodities, obtaining in return for them the rich productions of this province, which are esteemed the best of their kinds in Persia, and which for the last 50 years have been in such reputation, that Reshd is become one of the first commercial towns in this part of Asia. The finest sort of the silk of this province is usually white, and is chiefly sent to the inland cities of Persia, or is sold to the Turks. The inferior kind is yellow, and is principally disposed of among the Russians. From the great and constant demand for these silks, their price has for some time past been rising every year.—5. Tarabat, and 6. Medshetizar, on the southern coast, in the province of Mazanderan, are mere villages. In the latter, however, a considerable trade was for some time carried on, owing to its vicinity to Balfrush, the chief town of the province, whither the Russians and the Armenians were accustomed to bring their wares. This traffic has suffered a diminution, in consequence of the impositions of the khans of the province. Yet the port continues to be in some degree frequented, as well by the Russian merchants as by others from Kiskan, Ispahan, Scheeraz, Khorazan, &c. who bring with them the Persian and Indian products. From this province itself there is exported silk, much however inferior in quality to that of Ghilan; also large quantities of rice and cotton.—7. The bay of Astrabat, whence the Russians are accustomed to proceed in the prosecution of their mercantile business to the capital town of the same name. The products of the province of Astrabat, with its exports and imports, are nearly the same with those of Mazanderan. Astrabat trades mostly with Candahar. As to the roads, generally, of the southern coast of the Caspian, it may be observed, that, though they afford good clean anchoring ground, and in a sufficient depth of water, yet they are in this respect disagreeable, that they are so much exposed to heavy swellings of the sea, occasioned chiefly by the prevalence of the westerly winds. Few, if any of the ports of this sea, are altogether exempted from the like inconveniences.—The Tartarian ports are, 1. The Balkanskoi bay, and, 2. Mangushlak, both of which are situated on the eastern part of the Caspian, and which both, particularly the latter, have pretty secure roadsteads. The Russians visit the islands in the Balkanskoi bay, which are mostly inhabited by pirates of the race of Turkoman Tartars. They yield rice and cotton. One of them, also named from that circumstance, Naphthonia, furnishes a great quantity of naphtha. The commerce of Mangushlak is more considerable. To it the neighbouring Tartars bring the products of their own country and also those of Bucharia, such as cotton, yarn, stuffs, furs, hides, rhubarb, &c.

In consequence of the manner in which the Caspian Sea is inclosed on all sides by land, and its banks being so much in the vicinity of very high mountains, its navigation is, in some measure, necessarily of a peculiar kind. Certain winds domineer over it with such absolute sway, that vessels are often deprived of every resource; and of all the ports that have been enumerated, or if there are any other that occur throughout the whole extent of this sea, there is among them all hardly one that can be called perfectly safe.—There are no tides in the Caspian, but strong currents prevail in it, which, uniting their influence with that of the violent storms of wind so frequent here, and indeed common in some measure to this, with all other inland seas, occasion not a little difficulty and danger to the description of vessels which principally frequent it, and perplex and incommode extremely the rude and untutored sailors of the countries to which it is principally useful as a channel for their trade. These difficulties and inconveniences are farther increased, in consequence of the incredible numbers of shoals and small islands.

The vessels which frequent this sea, are commonly of rude construction, without decks, of such magnitude only as to draw from 9 to 10 feet of water, and carried forward by means of a single square sail, or by that with the addition sometimes of top sails. The long flat-bottomed craft which, among the Russians, have now taken place of the circular kind of vessels, that, at an earlier period, navigated this sea, are, in all their necessary appendages, more noted for a clumsy strength, than for any ingenuity in the mode of their formation. The vessels belonging to the Persians are commonly made of elm, which abound in their provinces southward of the Caspian: the sails are of cotton, the cables of flax, and some of the bark of trees. They have others of a somewhat different structure, and of larger dimensions, of the burden perhaps of from 30 to 40 tons, known by the name of sandalls, but which, notwithstanding the great attention directed in the manner of building them to the points of long duration and usefulness, are seldom in condition to keep the sea for more than 4 or 5 years. The most really serviceable, and indeed the most esteemed part of the Persian marine in this sea, seems to consist in the small boats called kirjiems, with which their necessary business in the different parts of the same, or in immediately contiguous districts, but, as may be easily supposed, nothing requiring a progress to any considerable distance, is conducted with sufficient economy and dispatch. The ship-builders of Persia are chiefly deserters from Russia; and from the number of shipwrecks which take place, as well as from the timidity and awkwardness with which every thing relating to the management of the vessels of this country while at sea is conducted, it would be well, that, unskilful as the Russians themselves are in this department, the navigation of these vessels were also placed in the same hands.

Of the provinces which surround and immediately border upon the Caspian Sea, those most towards the north are the kingdom of Astracan, and the territory of the Calmucks; whence proceeding by the west of it, round towards the same point, there occur the possessions of the Lesghee Tartars, Shirvan, the Mogan plains, Talish, Ghilan, Mazanderan, Astrabad, the Korgan desert, and other similar tracts, occupied or frequented chiefly by the Turkomans, or other tribes of independent Tartars, closing with the territory of the Kharakhulpacks, and of the Yaik Cossacs. The information obtained by travellers respecting these districts of country, is scanty and uninteresting, and will be given in another part of our work. On the banks of the Volga towards the north, chiefly in the province of Casan, there are large tracts of forest ground, which supply a sufficiency of oak and other timber for the construction of vessels, as well to be employed on that river itself, as to be engaged in the commerce of the Caspian Sea. Good timber for the same purpose is also found in Ghilan and the adjacent provinces subject to Persia; and iron ore might be obtained from Mazanderan. The country all round this sea, where not in the state of a desert, is very fertile in grain, fruits, and other productions, which are to the people dwelling in those parts the subjects of a lucrative commerce.

The water in the vicinity of the Caspian is frequently brackish; but here and there along its coasts, or in the islands which rise out from it, the vessels, by which it is frequented, may be supplied with water better fitted for use. In Hanway's Account of the British Trade over the Caspian, there will be found a journal by Captain Woodroofe, of the soundings, or other particulars of consequence, relative to the navigation of this sea, illustrated by proper maps and charts, on which is laid down every thing that seemed most deserving of notice, as well concerning the depths of the water round the whole coast, or in other situations in which any particular reason rendered it necessary that they should be known, as concerning the nature of the ground, the conveniences afforded for anchorage, and whatever else principally interests navigators, when entering upon seas little known to them. In Professor Pallas's Travels, there occur also various notices respecting the form, and the arrangement, and the distribution of particular parts, whether contained more within the main outline, or appearing in the character of excrescences, and a sort of appendages to this sea, with observations relative to its coasts and the adjacent country, or portions of these, as well as to some that appeared to deserve attention of the races or tribes of men by which these regions, or such parts of them, are inhabited. It may be just added, that the general condition of the principal provinces of Persia, bordering upon the Caspian,—Shirvan, Ghilan, Mazanderan, and Astrabad,—is, that though tributary to the Sophi, they are yet governed by their respective khans, who, occasionally rendering themselves independent, are constantly at war with each other, whence the places subject to their authority become the seats of disorder, of rapine, and devastation; and from the frequency and the exorbitancy of their exactions, of which some instances have been already adduced, the most serious obstacles are often thrown in the way of the success and the prosperity of trade. Robberies and piracies are here committed to a great extent. The different tribes of Tartars, which inhabit or roam along the coasts, have been particularly noted for such depredations; the Calmucks towards the north; the Lesghees in the west; and the Turkomans and others in the south and east. The robberies of the first of these tribes have been accompanied with degrees of cruelty and atrocity, indicative of the very depraved character of this people. The rigour of the punishments inflicted on them when taken, by those intrusted with the execution of the laws under the Russian government, (of which the Calmucks are now considered the subjects,) is not inferior to the measure of their own previous guilt.

The Caspian Sea, as has been already remarked, is the receptacle of many large rivers. The Emba, the Ural or Yaik, and the Volga, run into it from the north; the Kuma, Terek, Kur, and Kizil Ozen, from the west: those which it receives from the south are inconsiderable; but from the east it is supposed still to receive the Tedjen. Other rivers were understood formerly to disembogue themselves into it, some of which do not now exist; such are the Jaxartes and the Oxus, which are said to have flowed into it from the east, the latter particularly by one or two branches, till it afterwards bent northwards, and joined the sea of Aral.* It is probably owing to the great influx of river water into this sea, as well as to the nature of its bottom, that its water, particularly near to the shore, is so generally very turbid and impure. To the same circumstance it must be attributed, that though the taste of this water is salt, yet the proportion of salt found to be actually contained in any given quantity of it is comparatively inconsiderable. The degree of its saltness is said likewise to vary, not only with the depth, and according to the nearness to the shore, but also with the variation of the winds. Besides the salt and bitter taste common to it with all sea water, it has been observed, that the water of the Caspian has a certain peculiar taste quite distinct, and which affects the tongue with an impression similar to that made by the bile of animals. The degree in which this taste is perceptible at different periods is said, as in the other case just alluded to, to vary with the direction of the winds; and it has been attributed to the springs of naphtha, or other mineral or combustible substances, lying in the tract between Derbent and Baku, towards the west, or in the islands in the bay of Balkhan. Whether there is any plausibility in this notion or not, there is at least no doubt that the substances mentioned are found in and form a valuable production of these parts. Glauber salt, which is so intimately connected with naphtha in its nature and origin, is also observed to be a constituent in the water of the Caspian, as well as to enter into the composition of the saline earth, that is found in such quantity in efflorescence along its coasts. In particular situations, it is dug out of mines, which occur also in the same vicinity.

Much has been written respecting supposed periodical risings and fallings of the water of the Caspian; and it has been represented as a striking peculiarity, that for the space of thirty or thirty-five years its waters are constantly increasing, and then for the same term continually decrease. It has also been remarked, that, in proportion to the extent of this sea, the variety of its productions is by no means considerable. This has been attributed, and apparently with justice, to its want of communication with the ocean, which is thus precluded from imparting to it of its inexhaustible stores. But of the animals which this sea nourishes, the greater part are of very valuable kinds; and they multiply to such a degree, as to be a never failing source of profit and wealth to those of the contiguous nations, that are in a condition to turn them to account. Salmon, sturgeon, and other fish abound in all parts of the Caspian, as well as in the rivers which communicate with it. The salmon is as good as that of Riga and Archangel, and even more fleshy and fat. The herrings, too, are remarkably large, and plumper than the English or the Dutch, but not so tender. To this list of the fishes of the Caspian may be added, the sterlet, various species of seals, diversified, however, only or chiefly by their colour, and porpoises. The only shell-fish that occur are three or four species of cockle, the common muscle, some species of snails, and one or two others. This sea is much frequented by birds of various kinds. Those most commonly seen in its vicinity are storks, herons, bitterns, spoonbills, red geese, red ducks, and the like. The most beautiful of these is what is called the red goose, which, however, contrary to what is suggested by the name, is for the greater part white, having only the tips of the wings, the orbits of the eyes, the beak, and the feet of a scarlet colour. It is about the size of a stork, with long neck and legs, and, though it lives on fish, is very savoury to the taste. The same in this respect is the character of a species of wild ducks, which is also frequent in these parts, and which is noted for the sort of noisy concert that they perform in the evenings, on the tops of the trees or the roofs of houses. Other birds, properly aquatic, that occur here, are the grebe, the crested diver, the pelican, the cormorant, and almost every species of gull. Two kinds of leeches are found in this sea, the hog-leech and the dog-leech. The lurking places of those creatures have two apertures, one towards the south, the other towards the north, which they open and shut according to the changes of the wind.

Alexander the Great, with that attention which he was ever so ready to bestow upon whatever might be useful to commerce, gave, a short time before his death, directions to fit out a squadron in this sea, in order to survey it, and to discover whether it was connected either with the Euxine or with the Indian Ocean. Seleucus Nicator, also, the first and most sagacious of the Syrian kings, at the time when he was assassinated, entertained thoughts of forming a junction between the Caspian and the Euxine seas by a canal, and of thus extending the trade of his subjects in Europe, and supplying all the countries in the north of Asia, on the coast of the Euxine Sea, as well as many of those which stretch eastward from the Caspian, with the productions of India. And many ages afterwards, under the auspices of Peter the Great of Russia, a canal was made at Vishnei-Volotshok, by means of which a passage is had from the Caspian into the Volga, and thence, in conjunction with some rivers and lakes, into the Neva, and so into the Baltic. As to the actual commerce of this sea, ancient or modern, it is to be observed, that the maritime trade between the east and the west, which in every age has contributed so much to the opulence and power of the nations that have been fortunate enough to obtain the possession of it, was, in ancient times, long monopolized by Egypt, a country which, from its early and continued attention to naval affairs, had formed a powerful fleet, and obtained such a decided command of the sea, that it would have been vain for any other state to attempt to rival it in this trade. The Persians, in the mean time, though they had no intercourse by sea with India, yet being desirous to acquire a share in the valuable productions and elegant manufactures of that country, had them conveyed to all parts of their dominion by land-carriage. The part of these commodities destined for the supply of the northern provinces was transported on camels, from the banks of the Indus to those of the Oxus, down the stream of which they were forwarded to the Caspian Sea, and distributed through various channels over the different districts, bounded on one hand by that sea, on the other by the Euxine. The part of them intended for the southern and interior provinces, proceeded by land from the Caspian gates to some of the great rivers, by which they were circulated through every part of the country. While thus, however, in the several channels which they had respectively appropriated, the sovereigns and subjects of different states laboured with ardour and emulation to secure as far as possible to themselves the advantages of the trade with India, the power and consequence of them all was eventually swallowed up and lost under the devouring ambition and rapidly extending dominion of the Romans.

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* The Jaxartes is the Syr-Daria that falls into the Aral. The Oxus is the Ula, or the Amu-Daria, connected also with the same sea. See *D'Anville*; *Muller*; *Dictionnaire Geographique de Paloudinier*, art. *Aral*; and the general charts of the Academy of Petersburgh

From that period, we hear little for many ages of any commerce, or other proceedings upon the Caspian. But in modern times, the Venetians and Genoese, as early as the 14th century, had begun to transport, by way of this sea, the Indian, Persian, and Arabian commodities with which they supplied the southern parts of Europe, through Astracan, to their magazines at Azof and Caffa. From Astracan, the goods were conveyed up the Volga, then by land to the Don, and afterwards forwarded down that river to Azof. The northern part of the European continent was, during the same period, likewise supplied with those Asiatic goods, which were sent by the Russian traders over Astracan, to their principal magazine at Wisby, a Hanseatic town in the isle of Gothland. Towards the end of the century, in consequence of the devastations produced by the wars of Timur, a transfer took place of this trade from Astracan to Smyrna and Aleppo; and the Arabian commerce, for which, in fact, these places lay more convenient, never returned thither, though a part of the Persian traffic was afterwards restored to its old channel. While the provinces of Casan and Astracan remained under the government of the Tartars, the camp of the khan was a mart for the Russian and Persian merchants: and as, agreeably to the customs of that people, the site of their camp was often changed, Astracan and Terek became at length two principal places of resort. This commerce, frequently obstructed and interrupted by numerous banditti, was, however, precarious, until the conquest of Casan and Astracan by the Russians opened a ready communication between Moscow and the Caspian Sea; and then Ivan Vassilievitch II. having garrisoned Astracan with troops, rendered it the chief emporium of the eastern trade. This conquest having been effected previously to the end of the year 1554, soon after the discovery of Archangel, the English about that period obtained the Czar's permission to pass through his dominions into Persia, and to carry on an exclusive trade over the Caspian. In 1558, Jenkinson accordingly, the first Englishman who navigated that sea, landed at Mangushlak upon the eastern shore, passed by land through the country of the Turcoman Tartars to Bokhara, capital of Great Bucharia, and returned to Moscow in the following year. In 1561, he again sailed over the Caspian, and proceeding to the coast of Shirvan, went by land to Casbin, and obtained from the Sophi permission to trade into Persia. Similar expeditions were set on foot and conducted into the same parts by other merchants. The last of these was that under Christopher Burroughs, which was attended with many dangers, his ship being finally shattered by the ice in the mouth of the Volga, while the crew with difficulty escaped, and at length arrived at Astracan. Hitherto this traffic had been chiefly confined to the ports of Tumen, Derbent, Baku, and the coast of Ghilan; and having been much impeded by the banditti that frequent the shores of the Caspian, as well as by the wars which then prevailed between the Turks and the Persians, no English vessel during all that period, nor even for more than a century afterwards, ever appeared upon that sea. Indeed, for much the greater part of that time, the trade may be considered to have been altogether extinct; and no idea ever appears to have been entertained of its revival, till at length Peter I. having subdued the northern provinces of Persia, endeavoured to induce the English to engage anew in this commerce. The many unsuccessful attempts, however, that had been made in that department since the 16th century, and in which large sums had been lost, deterred them from entering into the views of that monarch; and so little, from various causes, chiefly the unwholesomeness of their climate, appeared now to be the advantage of possessing provinces which, at the time of their acquisition seemed to promise very benefical results, that, in consideration of obtaining the liberty of import and export duty free in all the harbours of the Caspian, with some other minor advantages, the empress Anne at length agreed to relinquish these provinces to Nadir Shah. Russia then gained more from them by trade, than before through the conquest and the possession of them; encouraged by which favourable appearance, as well as induced by other considerations, Captain Elton, an Englishman in the Russian service, renewed the project of instituting a British trade over the Caspian. Influenced by his persuasion, the British merchants of St Petersburgh turned their attention to this commerce. A vessel was built for the navigation of the Caspian. It was loaded with the goods considered to be the best adapted for the Persian market; and in fine, a factory was established at Reshd, in the province of Ghilan. Even, however, in the outset, the symptoms appeared of an inauspicious jealousy, and a tendency to disagreement among those who were to be concerned in this traffic; and eventually, in consequence as well of disputes among the English themselves, as between them and the Russians, and at the same time, probably moved, by views of ambition, Elton entered into the service of Nadir Shah, and assisted in constructing vessels by means of which the Persian court seems to have entertained the idea of establishing their own supremacy on this sea. This proceeding reasonably gave umbrage to the court of St Petersburgh, and Elizabeth, in 1746, withdrew her permission to the English merchants of passing through her dominions, on account of the Caspian commerce. On the death of Nadir Shah, who had for some time permitted the English to trade to Persia, their factory was pillaged, and their commerce annihilated. Elton, after various vicissitudes of fortune under those who, amidst the troubles which now began to prevail in this state, followed each other in rapid succession as the heads of its government, at length by a violent and premature death, paid the forfeit, either of his imprudence or of his crimes. The Russians profiting by the loss of the English in this quarter, received no small advantage from the models which they left them, and from learning of them in those parts, as they had before done in St Petersburgh, the use of the best materials for ship-building.

Considerably before this period, indeed, the natives of that country had entered into, and were now proceeding with no very unequal steps in the track opened by our merchants. Under Alexey Michaelovitch, Astracan became the centre of the Persian trade, to which place there resorted merchants from Bucharia, Crim Tartary, Persia, and even India. The vessels of the Russians, as has been already remarked, being rudely framed, without decks, and consequently exposed to frequent shipwrecks, the Czar drew from Amsterdam several shipbuilders, for the purpose of constructing others more calculated to weather the storms of the Caspian sea. His designs of improvement, however, were frustrated, in consequence of the rebellion of the Cossacks of the Don under Stenko Rasin, and the devastations occasioned by it; and in fine, the trade of Russia was for the present annihilated. When this revolt was quelled, the greater part of the commerce of the Caspian fell into the hands of the Armenian merchants established in Astracan, who settled factories in both the Russian and Persian territories. During this whole period, neither the Russian nor the Armenian traders had, for the most part, penetrated farther than Niezabad, and their chief settlement was at Shamachie, till the year 1711, when that town, having been taken by the Lesghees, the factory was destroyed. In 1721, Peter I. having obtained, as has been stated, the cession of the provinces of Dagestan, Shirvan, Ghilan, and Mazanderan, the commerce was renewed. He established a Russian mercantile company trading to the Caspian, with a capital of 400 achines, or shares, of the value each of 150 rubles, or 30*l.* The chief settlements were formed at Astracan and Kislar; but the right of property in those distant provinces having been resigned in the manner mentioned, the Russian merchants still retaining their exclusive privilege, now obtained the liberty of trading without payment of any duty to all the havens of the Caspian, and were allowed to build houses and magazines, subject to the single condition of obedience to the laws of the country. The benefit of the monopoly, with the other advantages enjoyed by this company, were confirmed to them by Anne and Elizabeth. Yet the commerce continued inconsiderable till, in 1762, Catharine II. abolished their exclusive privileges, and permitted for the future all her subjects, without exception, to take part in the Persian trade. On account of the numerous banditti that infest the roads, she at the same time prohibited the inland traffic from Kislar and the other Caspian ports to Shamachie. For the benefit of the legitimate and authorised trade, two Russian consuls have their residence statedly at Baku and at Einzellee. By degrees, the Russian trade on the Caspian rose to considerable consequence; it has, however, been a good deal injured by means of a contraband trade carried on in Shamachie and other inland Persian towns by the Armenian merchants, who, from their knowledge of the country and language, and from the terms on which, with these aids, they can make their purchases, have it in their power to undersell the Russians, in the parts which they severally frequent. Yet upon the whole, and owing chiefly to the various useful regulations introduced by the late empress, instead of the declining state into which it had for some time fallen, it has of late increased so much, that within the space of fifteen years, the average sum of the exports and the imports by the way of this sea, have been nearly tripled. The following is a general view of the state of this trade for several considerably distant years in the latter part of the last century. In 1760, the amount of the exports was 36,100*l.*, of the imports, 42,100*l.*, in all 78,200*l.*; with a balance against Russia of 6000*l.* In 1768, the exports were 87,700*l.*, the imports 63,700*l.*; the amount of the whole, 151,400*l.* Balance in favour of Russia 4000*l.* In 1775, the sum of the exports was 125,400*l.*, of the imports 64,120*l.*; giving a total amount of 189,520*l.*, to which is to be added the farther sum of 10,000*l.* for the traffic of Georgia and the nations of the Caucasus, making the whole sum 199,520*l.*; the balance, in respect to the part of this sum stated under the distinct heads of exports and imports, being in favour of Russia 61,280*l.* In these statements, it is to be understood, that no account is made of the contraband trade, the amount of which is also considerable.

The marine of the Caspian Sea at present, consists of two frigates of 12 guns each, two cutters, and a transport. There are besides fifty-six merchant vessels, viz. a pink, a transport, five galliots of about 30 lasts burthen each, and forty-eight schooners from 10 to 30 or 40, and one of 60 lasts. There are moreover 138 roshiven, or flat-bottomed vessels, employed in fishing and taking seals, or in the Mankishlak trade with the Trukhmenes and Boukharians.

The fishery on the Caspian is the most important branch of this business in Russia. Not only does this sea abound with most valuable kinds of fish; but it is so commodiously situated in the centre of the empire, it has so much the advantage of easy communications by water, and the trade is prosecuted in so good a method, that no where in the empire is so much benefit obtained in this department, in respect either of internal consumption or of commerce. In fact, according to the observation of Pallas, the fishery on the Caspian is, in some views, as important to Russia as the herring, the cod, and the whale fisheries, are to other maritime powers of Europe. That fishery on the northern shores of this sea is partly let out to Astracan merchants, whose great opulence is chiefly founded on it, and partly, in virtue of ancient privileges, belongs to the Uralian Cossacs, who claim this right, not only on the river Ural, but also for a space of 47 miles on each side of it. There are three principal seasons in which the fishing on the Caspian is prosecuted; the spring, the autumn, and the winter. As the sea is usually free from ice towards the latter end of March, the spring fishing usually begins immediately with the beginning of April. The business is usually undertaken by several contractors, each of whom has his particular station, or vataga, in a separate place, which commonly bears the name of the proprietor. At these vatagas, the kinds of fish that principally engage attention, are the several kinds of sturgeon, that properly so called, also the beluga and the sevruga. Shads and barbels are in an inferior degree likewise objects of request. The other smaller species of fish, which are found by a different class of adventurers to be well worthy of their care, are by those concerned in the greater fisheries disregarded. Each vataga prepared for the prosecution of this trade is occupied by from 50 to 80, or even 120 men, most of whom carry on a separate trade: there are also pilots, fishermen, salters, preparers of isinglass and caviare, and others. They have severally their small vessels of various dimensions and constructions, for the conveniency of going out occasionally to sea; with a galliot for fetching provisions and salt from Astracan, and for sending away the fish that have been taken. Adjacent to the buildings for the accommodation of the people employed, several sheds are erected, where the roes are prepared, the isinglass dried, and the stock of fish properly kept. For preserving the salted fish, deep and well-secured ice-cellars of considerable magnitude are dug under ground, which are floored with thick deals, and have large reservoirs lined with planks, in which the fresh fish are pickled in a strong brine. At the two sides of these brine vats, are parts divided off, in which the fish, on being taken out of the pickle, are placed in layers and sprinkled with salt; behind the compartments in which the fish are thus laid, the space to the side of the cellar is rammed full of ice, for the better preservation of this easily perishable commodity. The distance of one vataga from another is indefinite; as are also, in some degree, the bounds in which neighbouring vatagas may fish. The taxes paid by these vatagas to the crown are rated by their quantities of prepared roes and isinglass; for every pood of isinglass five rubles, and for a pood of roes two rubles eighty copecs, being paid into the caisse.

About the beginning of the fishing season in spring, myriads of little fish are observed pressing towards the shore, of which the obla particularly, a sort of scale-fish, is caught and kept alive in wells to serve the purpose of baiting the hooks, during the continuance of the season. This little fry is followed by prodigious swarms of ravenous belugas; the time for the capture of which is seldom longer than two full weeks; on which account the fishermen are obliged, during that period, to work day and night. In good years a vessel, while the swarming lasts, may within 24 hours bring up 50 or more of these large fish. The manner of taking them is by means of a machine, consisting of a rope 70 ells in length, to which there are attached 125 lines, each 1½ fathom long, with as many large angling hooks. This rope, with the number of hooks mentioned, is technically termed a nest; and 30 of these nests tied together commonly belong to a machine, which is therefore several hundred fathoms in length. Between every two nests there is tied a stone of some pounds weight: the two ends of a whole machine are furnished with wooden anchors; and generally the adjustments are in all respects such that it may not easily be removed out of its place, and that no fish, when once caught, may have it in its power to escape. After they have been laid, these machines are visited twice in the day; the hooks are cautiously taken up along the rope; and a cord being passed through the gills of the fish caught, they are let down again into the water, in order that they may be brought on shore alive. They are now dragged with hooks to the beach, which is laid with planks, and are cut up in the following order: the lower part of the stomach, with the guts, are thrown away; the fleshy gullet is salted for eating; the roe, which lies through the whole body adjoining to the entrails, is taken out with the hand and cast into tubs, in which it is carried away by the caviare makers; the float, or sound, which runs along the whole back, is given to the isinglass makers; then the cartilage of the back being cut off in order that the dorsal sinews may be extracted; these are washed, hung upon poles, and dried in the air; and the entrails being removed, the fat adhering about the milt and to the sides is scraped off with knives, collected, boiled down, and cleansed, in which condition, having a good taste, it is used occasionally instead of butter or oil. The fish, after these preparatory processes, are brought into the cellar above described, where they are first laid to pickle in brine, then strewed with salt, and laid up in courses one above another, to be preserved for use. These belugas are frequently of a great size. One is mentioned which is said to have measured 8½ arshines in length, (each arshine being 28 English inches,) to have weighed 70 pood or 2800 pounds, and to have yielded 20 pood of roe. They are not uncommonly taken of 1000 or 1500 lb. weight.

When the shoaling of the beluga has ceased, it is immediately succeeded by the train of the sevrugas, which appears only once in the year, and also lasts not much above 2 weeks, but during that short space it is exceedingly numerous. At one vataga, with a favourable sea breeze, it is usual to catch in a season sixteen and sometimes twenty thousand of these fish. The nets made use of for this purpose are so thick, that the machines are only a span wide: 25 of them are tied together, and laid at the depth at most of a fathom, as the sevrugas frequent chiefly the shallow places. These fishes seldom exceed 4½ arshines in length; but their roes, as well as their sounds, are much more esteemed than those of the beluga, and consequently bear a higher price. The flesh is partly salted down, and partly dried in the sun.

The sevrugas, as has been observed, make for the bays only in the spring season, which is the time at which they spawn. At this period the belugas are without roes, and proceed thither only in quest of prey. In the autumn and the winter, those latter fish therefore return thither again, either with a view to spawning, or to pass the winter. These two species of sturgeon, seeking, for the purpose mentioned, fresh or moderately salt water, repair annually at the stated seasons not only to the rivers, but also to the gulfs and bites of the sea; whereas the real sturgeon, requiring on the like occasions still greater freshness of water, proceeds always directly to the mouths of the rivers without tarrying in the bays. These fish, therefore, are caught only or chiefly at those vatagas, which are at the mouths of the Volga, and on the river itself; and a sturgeon is such a rarity at the fisheries on the bays of the sea, that, by a very ancient custom, it is the property of the person by whom it is drawn out of the water.

The autumn capture for the beluga, begins in the middle of September and continues through all October. The winter capture of the same description of fishes, begins as soon as the ice is set in on the sea, and lasts the whole of that season. The same machine is used for the purpose as formerly, but it is now set under the ice, apertures being with that view cut in it at the distance severally of 8 paces asunder, through which the rope is introduced by means of long poles. Where two nests are tied together, the machine is fastened to a cross pole, which rests on the brink of the aperture. For bait, there is provided a sufficient stock of obla fish to last during the winter, which are previously salted, with a view to their preservation. The belugas caught, are conveyed over the ice on sledges to the vataga, immediately frozen fresh, and carried to Astracan.

Other fisheries of the same descriptions with those now enumerated, and these also of considerable importance, are established on the rivers which run into the Caspian, particularly on the Volga and the Ural. The seal capture, which is carried on by the more opulent part of the Astracan merchants in the Caspian Sea, is found to be very profitable. Those animals are here very numerous. They crawl upon the islands, where the fishermen kill them with long clubs. One is hardly dispatched, when others come to his assistance and share his fate. They are exceedingly tenacious of life, and will endure more than 30 hard blows before they die. They will even live for several days after having received many mortal wounds. They are most terrified by fire and smoke, and, as soon as they perceive them, retreat with the utmost expedition to the sea. They become extremely fat, so as to look rather like oil-bags than animals. The principal seasons for taking them are the spring and the autumn. Many small vessels, at these seasons, go out from Astracan in quest of them; and those which are killed, being immediately gutted and powdered with salt, are sent thither, where they are flayed, and their tallow melted. A sort of grey soap is here made of this fat, mixed with potashes, which is much valued for its property of cleansing, and taking grease out of woollen stuffs. The inhabitants of Astracan, by salting their seals in the manner mentioned, immediately on the spot, gain this advantage, that the tallow is much cleaner and better than that of the seals taken at Archangel, or other places where a different mode of procedure is adopted.

Besides the great vatagas, the proprietors of them have fishing huts here and there on the sea coasts, where there is no capture of sturgeons, at which, mostly in summer, shad and barbels are taken with drag-nets. These two kinds of fish do not go into the rivers at that season, but keep about the sea shore, where they find a better nourishment. The shad here usually weigh 8 pood, and the barbel 1½ pood. The former sort of fish are extremely fat in summer: their roes are thrown away; but of the sounds an ordinary sort of fish glue is made.

The following is the estimated amount of the number of large and small fish taken annually in the lower branches of the Volga, and the inlets of the Caspian Sea, and of their value. The account is extracted from the joint returns of the principal proprietors of the fisheries, and those of the public brokers at Astracan, who are obliged to certify the exports of fish by permits. It exhibits the average of the returns for 4 years, admitting only the lowest prices during that period.

Of the belugas, or great sturgeon, the number is stated to be 103,500. Each fish being reckoned at the price of only 2½ rubles, the value of these will be 258,750 rubles. A thousand sturgeons produce about 7¼ pood of isinglass: the above number consequently 776 pood, which valued only at 60 rubles a pood, is 46,560 rubles. The roe or caviare of 1000 sturgeons weighs 100 pood, or 4000 pound weight. The amount of the roe obtained from the whole will therefore be 10,350 pood, which, at 3½ rubles, gives 36,225 rubles. Thus the entire product of the fisheries of the great sturgeon will amount to 341,535 rubles.

Of the small sturgeon, the number taken is estimated at 302,000, which, at 1 ruble 30 kopeeks, will give 392,600 rubles. The quantity of isinglass obtained from them, valued in a similar manner as above, will give 41,525 rubles; their roe or caviare 63,420 rubles; making in all accordingly the produce of this fishery, 497,545 rubles.

Of the sevrugas, the number obtained annually is stated at 1,345,000. Their price is reckoned to be 538,000 rubles. The return from these in isinglass is rated at 100,875 rubles; and in caviare, at 282,450 rubles: thus making the whole produce of the sevrugas 921,325 rubles.

In this manner, the whole value of the sturgeons of different kinds, caught in the waters of Astracan and the Caspian Sea, appears to amount to the annual sum of 1,760,405 rubles, according to the average price. In addition to this produce, is to be reckoned that also of the smaller species of fish taken in these fisheries, such as carp, pike, and shads, which may be valued at half a million of rubles. The number of seals taken in the Caspian Sea, is to be also included under the head of the productive branches of industry. It is thus easy to perceive of how much consequence those fisheries, with the considerable ones also upon the rivers that run into the Caspian, must be in respect both to employment and provision to the people in the vicinity, as well as to those who live at greater distances from it.

See Pallas's *Travels*; *Voyage dans l'Empire Othoman, l'Egypt, et la Perse*, par G. A. Olivier; Coxe's *Travels*; Tooke's *View of Russia*; Guldenstadt *Treat. Von der Hafen am Caspeschen meere in Journ. St Pet. for* 1777; Hackluyt's *Collect. of Voyages*; Cooke's *Travels through the Russ. Emp. to Persia*; Gmelin's *Reese Journ. St Pet.*; Hanway's *British Trade over the Caspian*; Robertson's *India*; *Bibliotheque Universelle des Voyages*, par G. Boucher de la Richarderie; *Voyages de* Sauveboeuf, &c. (K)

CASSEL, the capital of the kingdom of Westphalia, is situated in the department of the Fulda, and on the river Fulda, which divides it into two parts, called the old and the new town, which are joined by a bridge. The old town, which is the largest of the two divisions, is very ill built. The houses are mostly old, and formed of timber, and the streets are narrow and irregular. The new town is subdivided into the upper and the lower. The upper portion, which was also called the French town, is ill built; but, in the lower part, the houses are elegant and well built, and the streets straight and spacious.

The principal public buildings and curiosities, are the Castle of Residence and its colonnade—the Palace—the Bath of Marble—the Museum—the Square of Frederick—the Arsenal—the Catholic church—the Foundling Hospital—the Anatomical Theatre—the Reformed Church, where there is a statue of the Landgrave Charles—the Foundery—the Palace of the Prince Guise—the Opera House—the buildings of the Orangery—the Observatory—the Menagerie, and the Place Royale.

The Museum, which was built by the Landgrave Frederick II., is a noble building. It has a façade of 290 feet long, with columns of the Ionian order, 36 feet in height. It contains a valuable collection of antique gems and ornaments, statues, busts, and cast models of Rome, and particularly of all the Princes of Hesse, dressed in the costume of their times. In the Square of Frederick is a statue of the late Landgrave, by Nahl, erected in 1783. The Manege is a light and elegant building, and the library is a magnificent apartment, about 500 feet long by 40, and contains several valuable books and manuscripts.

The literary establishments of Cassel, are a society of antiquity; an academy of painting; a cabinet of machines and models; a college; the lyceum of Frederick; and the society of agriculture and the fine arts. The principal promenades are the park of Augarten, the garden of Bellevue, and the esplanade.

In the neighbourhood of Cassel is the beautiful castle of Wilhelmshole, formerly Weissenstein, which is visited by all strangers. The fine cascades; the colossal Hercules of Winterkasten; the lofty jet d'eau; the Loewenbourg; the aqueduct; and the fall of water, are objects of general admiration. The garden of Freyenhagen, the chateau, gardens, and grottos of Wilhelmshole, are among the other curiosities in the neighbourhood.

The principal manufactures of Cassel are porcelain; delft ware; woollen stuffs; fine hats; ribbands; silk and woollen stockings; gold and silver lace; tobacco; wax candles; chocolate; buttons; and cards for playing. M. Kuttner reckons Cassel the fourth city in Germany, and inferior only to Vienna, Berlin, and Dresden. East Long. of the observatory 9° 35′ 18″, North Lat. 51° 19′ 20″. Population in 1811, 20,260. See Tynnas' *Almanach du Commerce pour* 1811. *Verzeichniss der hochfurstlich Hessischen Gemalde Samusburg in Cassel*, 1783. *Cassel und die umliegende Gegend. Cassel* 1796, by M. D'Apel; Trotter's *Memoirs of Mr Fox*, p. 51. (π)

CASSIA, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, p. 203.

CASSIMERE. See CASHMERE.

CASSINE, a genus of plants of the class Pentandria, and order Trigynia. See BOTANY, p. 161.

CASSINI, JOHN DOMINIQUE, a celebrated French astronomer, was born at Perinaldo, in the county of Nice, on the 8th of June, 1625, and was descended from a family, which has ranked among the senatorial families of Sienna since the time of Cardinal Cassini, who was archbishop of that city in 1426. After receiving the early part of his education under a private tutor, he was sent to the college of Jesuits at Genoa, where he made such a rapid progress in literature, that some of his Latin poems were published when he was only eleven years of age. In consequence of some books on judicial astrology having been lent to him by an ecclesiastic, when he was on a visit at the country house of M. Lercaro, the doge of Genoa, his attention was directed to the study of the heavens. He began to predict future events from the aspects of the heavenly bodies, and made numerous extracts from the astrological books which were put into his hands; but having accidentally read the work of Pic de la Marandi against astrologers, he burned all the extracts which he had made, and abandoned for ever the dreams of astrology. He now devoted himself wholly to astronomy; and such was the rapidity of his progress, that in the year 1650, when he was only twenty-five years of age, he was invited by the senate of Bologna to the professorship of astronomy, which had been vacant for several years by the death of Cavalleri; a situation in which he continued for several years, devoting the whole of his leisure time to astronomical observations. From a series of observations on the comet of 1652, made with the Marquis of Malvasia, who had been instrumental in bringing him to Bologna, he concluded that comets were not of a meteoric nature, as had been imagined, but that they were guided in their paths by the same laws as the planetary bodies; and he explains the motion of the comet by a circle described round the earth and beyond the orbit of the moon. These observations were published in his first production, which appeared in 1653, under the title of *De Cometa anni* 1652 *et* 1653. Muntinæ, fol. In the same year he obtained a solution of the celebrated problem for determining geometrically from the mean and true place of a planet, the eccentricity of its orbit, and the place of its apogee, which had baffled the ingenuity both of Kepler and Bullialdus. In 1653, when the church of St Petronius at Bologna underwent a repair, Cassini obtained permission to draw the famous meridian line, which we have already described in our account of that city. This meridian line, which had been first drawn in 1575 by Egnazio Dante, was renewed in 1695 by Cassini, when a full account of it was published by him, entitled, *La Meridiana del tempio di S. Petronia, tirata è preparata per le osservationi astronomiche l'anno* 1655, *rivista è restaurata l'anno* 1695. Bologna, fol. In the year 1657, Cassini went to Rome in the capacity of assistant to the Marquis Tanara, who had been sent by the senate of Bologna as ambassador to Pope Alexander VII. respecting certain differences which had arisen between the cities of Bologna and Ferrara, about the inundation of the Po; and such was the skill and judgment which he displayed on this occasion, that he was chosen superintendant of the waters of the state of Bologna. Marius Chigi, the Pope's brother, afterwards appointed him in 1663, inspector general of the fortifications of the castle of Urbino, and he was also chosen engineer for all the rivers in the ecclesiastical state. Cassini was employed in settling with M. Viviani the difference which arose between Pope Alexander VII. and the Grand Duke of Tuscany, respecting the waters of the Chiana; and such was the personal regard which this pontiff entertained for him, that he frequently sent for Cassini to converse with him upon the sciences, and urged him, in vain, by the promises of preferment, to enter into the church.

During these occupations, which were rather foreign to the habits of a practical astronomer, Cassini found leisure to prosecute his favourite study. He observed almost all the celestial phenomena which occurred, he discovered the rotation of Mars upon his axis, and he formed tables of the motion of Jupiter's satellites. His various observations made in his native country were published in the following works:

1. *Specimen Observationum Bononiensium Æquinoctii verni, anni* 1656. Bonon. 1656, fol.

2. *Varie figure intagliate in rume, che representano la perspettiva di Pianetti un le proporzione delle loro distanze al Sole et alla terra, periodiche revolutioni, direzzioni e retrogradationi.* Bonon. 1659, fol.

3. *Epistolæ Astronomicæ cum tabulis ad Marchion Malvasiam insertæ in ejusdem Malvasiæ ephemeridibus.* Muntinæ, 1662. fol.

4. *Epistolæ de observationibus in D. Petronii templo habitis.* Bonon, 1663. fol.

5. *Osservatione de eclisse Solare fatta in Ferrara anno* 1664, *con una figura intagliata in rame, che representa uno nuovo methodo di trovar le apparenze varie che fu nel medesimo tempo in tutta la terra.* Ferrara, 1664. fol.

6. *Theoria motus Cometæ anni* 1664. Romæ, 1665.

7. *Lettere astronomiche al Signor Abbate Ottavio Falconieri sopra il confronto di alcune osservazioni delle comete dell' anno* 1665. Romæ, 1665. fol.

8. *Lettere astronomiche sopra l'ombre de pianeti Medicei in Giove.* 1665. Rom. fol.

9. *Quatro lettere al Signor Abb. Falconieri, sopra la varieta del macchie osservate in Giove, e loro diurne revoluzioni con le Tavole.* Rom. 1665. fol.

10. *P. Gottigniez et* Joann. Dom. Cassini *Epistolæ duæ astronomicæ, de difficultatibus circa eclipses in Jove a Mediceis planetis effectas, aliaque noviter in ipso detecta.* Bonon. 1665. fol.

11. **Dissertationes Astronomicæ Apologeticæ.* Bonon. 1665. fol.

12. *Epistola ad Geminianum Montanari de refractionum celestium methodo.* Bonon. 1665. fol.

13. *Martis circa axem proprium revolubilis observationes Bononiæ habitis.* Bonon. 1666.

14. *De Solaribus Hypothesibus et Refractionibus, Epistolæ tres.* Bonon. 1666, fol.

15. *Disceptatio apologetica de Maculis Jovis et Martis ann.* 1666, 1667, *et de conversione Veneris circa axem suam.*

16. *Ephemerides Bononienses mediceorum siderum.* Bonon. 1668.

17. *Spina Celeste, meteora osservata nell' anno* 1688 *in Bologna.* Bonon. 1668. fol.

18. *Nova ratio inveniendi metrice et directe apogea, excentricitates, et anomalias motus planetarum.* Bonon. 1669.

Cassini's tables of Jupiter's satellites having accidentally fallen into the hands of the celebrated French astronomer M. Picard, he conceived a high opinion of the abilities of their author; and such was the fame which that work acquired, that Louis XIV. was anxious to number him among the members of the French academy. Cassini, however, declined the invitation, which was transmitted to him, unless the consent of his superiors was obtained; and Pope Clement IX. and the senate of Bologna having yielded to the solicitations of the French king, Cassini was granted leave of absence for six years. In the beginning of the year 1669 he came to Paris, and in the same year he was appointed astronomer royal, and was admitted a pensioner of the academy. When his time of absence was about to expire, the Pope and the senate of Bologna insisted upon his return, on pain of forfeiting all his emoluments and revenues, which he had hitherto been permitted to enjoy. The minister Colbert induced him to remain, and in the year 1673 he was naturalized and entered into the married state.

The completion of the royal observatory in 1670, enabled Cassini to devote himself, without interruption, to practical astronomy. In September 1671, he began his laborious career, and during the period of 41 years he made more observations than was perhaps ever done by any individual astronomer. These observations are recorded in no fewer than 165 memoirs, with which he enriched the Memoirs of the Academy of Sciences, and they contributed greatly to extend the science of astronomy. Cassini made a set of regular observations on the equinoxes and solstices, and on the oppositions and conjunctions of the planets. On the 5th of October 1671, he discovered the *fifth* satellite of Saturn; on the 23d December 1672 he discovered the third; and in the month of March 1684, he discovered the first and second satellites of the same planet. He had the merit also of discovering the rotation of the fifth satellite, the belts of Saturn and Jupiter, the spheroidal figure of Jupiter, the zodiacal light, and he was the first who gave a satisfactory theory of the moon's libration.

In the year 1695, Cassini undertook a journey to Bologna in company with his son, for the purpose of examining the meridian line in the church of St Petronius, which he had drawn in 1655, and he found that it had not sustained any variation in the course of 40 years. In 1700, he continued, to the very south of France, the meridian line which Picard had begun, and he published an account of the undertaking in the Memoirs of the Academy for 1701, under the title of *De la Meridienne de l'Observatoire Royale, prolongée jusqu' aux Pyrénées.* In the latter part of his life Cassini lost his sight, and he died without any disease on the 14th of September 1712, at the advanced age of 87. He had lost his eldest son at the battle of La Hogue; and he was succeeded in the observatory and in the Academy by his youngest son, the subject of the following article.

Besides the works which Cassini printed in Italy, and the 165 memoirs on astronomical subjects, he published the following 11 memoirs on general subjects: 1. *Observations sur la Maniere de faire de puits, et des jets d'Eau a Modene,* Mem. Acad. 1666, tom. i. 2. *Sur la Balance Arithmetique.* Id. p. 142. 3. *Sur un Nouvelle Progression des Nombres.* Id. p. 201. 4. *Sur un Eau renfermée dans un Bouteille, et qui fumoit continuellement des qu'on en otoit le Bouchon.* Id. p. 242. 5. *Sur la quantite d'Eau necessaire pour faire d'aller un moulin.* Id. p. 286. 6. *Sur un Meteore en forme de Globe de feu de la grandeur de la Lune vu en* 1687. Id. tom. ii. p. 19. 7. *Sur la Figure de la Neige.* Id. p. 87. 8. *Sur l'Eruption du Vesuve en* 1694. Id. p. 127. 9. *De la Figure de la Neige.* Tom. x. p. 25. 10. *Sur de Parhelies vues en Janvier* 1693. Id. tom. ii. p. 1 3. 11. *Sur un Balance Arithmetique.* Machin. Approuv. Tom. i. p. 143. Cassini also made many observations on insects, addressed to M. Montalbani, who published them in the works of Aldrovandus. He likewise made a number of experiments on the transfusion of blood.

Cassini published also the following separate works. *Nouvelles Observations des taches du Soleil, avec quelques autres Observations sur la Saturne.* Paris, 1671,

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* This work contains, among other things, a dissertation on the spots of Mars and Jupiter, and a reply to two brothers of the name of Serris, who maintained that Fontana had discovered the rotation of Mars.

4to. *Observations et Reflexions sur la Comete de* 1672. *Decouvertes de deux nouvelles Planetes autour de Saturne.* Paris, 1673, fol. *Observations et Reflexions sur la Comete de* 1680 *et* 1681. Paris, 1681, 4to. *Nouvelles decouvertes dans le Globe de Jupiter.* Paris, 1790, 4to.

The following works were left unfinished, or in MS. *Nuncii Siderei Interpres. Magna periodus lunisolaris et Paschalis duobus libris comprehensa, quorum primus magnæ periodi fundamenta ejusque usum exponit, alter usum ejus civilem et ecclesiasticum. Une Cosmographie ou une description du Monde;* en vers Italien. *Tables des Mouvemens du Soleil et de la Lune.* (*o*)

CASSINI, James, a celebrated astronomer, was the youngest son of John Dominique Cassini, and was born at Paris on the 18th of February 1677. After having finished his studies in his father's house, under the care of M. Chazelle of the Academy of Sciences, he was sent to study philosophy at the Mazarin college under the celebrated Varignon, who was then professor of mathematics; and so great was his progress, that, at the age of 15, he supported a mathematical thesis, which he dedicated to the Duke of Burgundy. In the year 1694, at the age of 17, he was admitted into the Academy of Sciences; and, in the year 1695, he accompanied his father to Italy, assisted him in verifying the meridian line at the church of St Petronius, measured the length of the Roman and Greek foot, and determined the latitude of several of the cities through which he passed. Upon his return from Italy he went to Holland, where he determined the latitude of several places, and discovered some errors which Snellius had committed in his measurement of the earth. Towards the end of the year 1696, he undertook a journey to England, where he became acquainted with Newton, Halley, Flamstead, Gregory and Wallis, and after remaining some time, he returned to France with an additional ardour for his favourite science, and adorned with the title of Fellow of the Royal Society.

In the year 1712, James Cassini succeeded his father as Astronomer at the Royal Observatory of Paris; and every volume of the Memoirs of the French Academy contains numerous proofs, both of his assiduity as an observer, and as a physical astronomer. In the year 1705, he presented his paper on the method of determining the longitude of places, by the eclipses of the fixed stars and planets by the moon. His researches on the magnitude of the fixed stars, and their distance from the earth, appeared in 1717; and, in the same year, he published his Theory of the Motion of the Satellites of Saturn. In 1720, he published his work, entitled, *De la Grandeur et de la Figure de la Terre.* In his paper on the revolution of Venus round her axis, which was printed in the Memoirs of the Academy for 1732, he confirmed the results of his father's observations, by pointing out the mistakes committed by Bianchini; and this determination has been completely established by the very recent observations of M. Schroeter. His attention was next turned to the curious subject of the acceleration of the mean motion of Jupiter, and the retardation of that of Saturn; and he shewed that the mean motion of Jupiter should be accelerated half a second every year, while that of Saturn was retarded two minutes in the same time; and that these quantities should increase for 2000 years, and afterwards diminish.

In the year 1740, Cassini published his *Elemens d' Astronomie*, accompanied with Astronomical tables of the sun, moon, planets, stars, and satellites. The Elements of Astronomy were composed at the request of the Duke of Burgundy, who was solicitous to have in his own language an elementary treatise on that science. The astronomical tables, which were long reckoned the most accurate, were afterwards reprinted by his son, but with many errors, from which the original edition was free.

Although the attention of Cassini was chiefly directed to the study and practice of astronomy, yet the other branches of physical knowledge occasionally attracted his notice. Besides 172 memoirs on astronomical subjects, which were printed by the Academy of Sciences, he published eight upon the following subjects:

1. Experiences sur le recul des armes a feu. *Mem. Acad.* 1703. Hist. 98.
2. Reflexions sur les regles de la condensation de l' air. *Id.* 1705, p. 61. and p. 272.
3. Observations sur la lumiere des corps frottées. *Id.* 1707. Hist. 3.
4. Experiences sur les armes a feu differemment chargees. *Id.* 1707. Hist. 3.
5. De la necessite de bien centrer le verre objectif d'une lunette. *Id.* 1710, p. 223.
6. Experiences de l'effet du vent à l'egard du thermometre. *Id.* 1710, p. 544.
7. Reflexions sur les observations du barometre qui ont eté faite sur les montagnes du Puy-de-Dome, du Mont-d'Or, et du Canigou. *Id.* 1740. Hist. 79.
8. Methode de se servir des Miroirs concaves, de metal ou de verre pour tenir les metaux en fusion, &c. *Id.* 1747, p. 25.

Our author was employed, along with Maraldi and De la Hire the Younger, in completing the measurement of a degree of the meridian, which had been begun by Picard, and continued by Dominique Cassini; and he finished this work in the year 1718. The latitudes observed in several points, in an extent of more than six degrees, shewed an inequality in these degrees; and M. Cassini maintained, that the degrees of the same meridian diminished towards the poles, and consequently that the earth was a prolate spheroid. This result, so contrary to the Newtonian theory of gravity, induced the French government to measure a degree at the equator and near the poles, the result of which overturned the opinion of our author.

In the year 1704, Cassini had been appointed master of accounts, and he discharged the duties of this office with such activity and zeal, that, in 1716, he was one of the small number of magistrates who were chosen to compose the Chamber of Justice.

While our author was on the road to his country house at Thury, he was unfortunately overturned, and, having become instantly paralytic, he died of his wound on the 15th April 1756.

Cassini was large and well made, and had a very interesting physiognomy. Distinguished by piety and beneficence, he was one of those persons who obtain that universal esteem to which they were justly entitled. In 1710, Cassini married Mademoiselle Ducharmoi, the daughter of the Countess of Sissonne, by whom he had six children, one of whom died when young. His two daughters were well married, and his three sons rose to eminence in their respective professions. (*o*)

CASSINI de Thury, Cæsar Francois, was the second son of James Cassini, and was born at Paris on the 17th June 1719. He received his earliest instructions in astronomy and geometry from M. M. Maraldi and Camus; and when he was scarcely ten years of age, he calculated the phases of the total eclipse of the sun, which happened in the year 1727. At the age of eighteen, he accompanied his father in his two journies, for the purpose of drawing a perpendicular to the meridian of the observatory from Strasburg to Brest; and, in the year 1735, he was received into the academy as adjunct supernumerary at the early age of twenty-one.

A general chart of France having been about this time meditated, it became necessary to traverse the kingdom with several lines parallel to the meridian, and to the perpendicular to the observatory. Cassini was charged with this undertaking; and, as the measurements taken by his father and grandfather were not exempt from errors, he undertook to draw anew the meridian of Paris, by means of a new series of triangles, smaller in number, and more advantageously arranged, than those which had been formerly used.

A full account of this survey was published by Cassini in the Memoirs of the Academy for 1744, under the title of *Meridienne de l'observatoire de Paris verifiée dans toute l'etendue du royaume, par de nouvelles observations, &c. avec des observations d'Histoire naturelle faites dans les provinces traversées par la Meridienne.* The series of triangles used on this occasion, passed along the sea coast to Bayonne, traversed the frontiers of Spain to the Mediterranean, stretched as far as Antibes, and round by the eastern frontier of France to Dunkirk. This map of triangles was terminated by two columns, on which were marked the longitude, latitude, and distance from Paris, of all the towns comprehended in the chain of triangles.

When the war broke out in Flanders in 1741, Cassini accompanied the king to that country, and took advantage of this opportunity of verifying the measure of a degree by Snellius. From the materials which he had collected, he prepared a particular chart of that part of Flanders which had been occupied by the French armies, and the king was so much pleased with its accuracy, that he expressed his desire to have a chart of France prepared in the same manner. M. De Machaud, who was then comptroller general, furnished the money which was necessary for this undertaking; but these advances were discontinued by his successor M. de Sechelles, and the King, out of regard to Cassini, announced to him personally this disagreeable intelligence. "Sire," replied Cassini, "if you will only deign to say that you view with concern the suspension of this undertaking, and that you wish for its continuance, I shall take charge of the rest." The king readily consented to this request, and Cassini immediately formed the plan of a company who should make the necessary advances, and repay themselves by the sale of the charts. This company was formed, and Cassini had the satisfaction of seeing his great undertaking accomplished. He published different works relative to these charts, and each sheet, the number of which was 183, was accompanied with an alphabetical table, containing the distance from the meridian, and from the perpendicular, of all the different places.

These charts of France inspired the sovereigns of other countries with a desire of having their own kingdoms surveyed, and, in 1760, the emperor invited M. Cassini to Vienna, for the purpose of continuing to that city the perpendicular to the meridian of Paris. On the 6th of June, 1761, he observed at Vienna the transit of Venus, an account of which he published in his *Voyage en Allemagne*, a work which contains many notices respecting the geography of the country, and the charts of Frich and Muller. He published a new map of that country, which represented a series of triangles from Strasburg to Tyrnau in Hungary.

In pursuance of his great plan, Cassini proposed to the British government to connect the general chart of France with that of the British Isles. This proposal was favourably received, and the trigonometrical survey of this country, of which we shall give a full account in another part of our work, has been carried on with the greatest ability by General Roy and General Mudge.

The attention of M. Cassini was not diverted from his astronomical studies, by the various geographical labours in which he was engaged. He published, in 1756, additions to the astronomical tables of his father. The comparison of a great number of observations of the moon with the tables, induced him to apply another equation, whose period was 19 years. In 1770 he published three almanacks, which were accompanied by an universal instrument invented by the Prince de Conti. The papers which he printed in the Memoirs of the Academy, between the years 1735 and 1770, amount to 70, and are all upon astronomical subjects.

Though Cassini had naturally a strong constitution, which enabled him to undergo the greatest fatigue in the course of his geographical labours; yet, in the latter part of his life, he was siezed with a habitual retention of urine, which rendered the last 12 years of his life particularly painful and distressing. In the month of August 1784, he was attacked with the small pox, of which he died, on the 4th September, in the 71st year of his age. He left behind him a daughter, and a son, the Count de Cassini, who succeeded him in the observatory, and, till about the end of the French revolution, continued to prosecute the study of his ancestors. The pleasures of a country life, however, have drawn him from these pursuits; and his son, who forms the fifth generation of the Cassinis, has exhibited no attachment to a science with which the name of his family will be for ever associated. (*o*)

CASSIOPEIA. See ASTRONOMY, p. 699.

CASSIUS, CAIUS, was a celebrated Roman, who sustained a most important part in opposing the revolutions which had been planned by Julius Cæsar at a very early age. He was descended from ancestors who had made a considerable figure in the state; and as the tone of temper of some, if not of the same family, at least of the same name, bore a great resemblance to the ardour and impetuosity for which he himself was so distinguished during the whole course of his enterprising and eventful life, it has been affirmed, that one of them, Sp. Cassius, after a triumph and three consulships, was put to death by his own father, in consequence of attempting to encroach upon the liberties of his country. Of the truth of this circumstance, however, as well as that of many others in the earlier part of the Roman history, it is reasonable to doubt. Young Cassius is represented to have discovered at school a very high spirit of independence, and to have given intimations of that imperious and ungovernable disposition, which never forsook him, even in those transactions which involved the fate of Rome itself. Faustus, the son of the dictator Sylla, had boasted of the greatness of his father: Cassius, whose family was equally hostile to Sylla with the other families in Rome, chastised his companion with as much freedom as if he had been the son of the meanest Roman citizen; and, in after life, he declared to Pompey, who had alluded to the story, that if Faustus were to refer to the same circumstance, he would repeat the blow. At the usual age he was created quæstor, which was the first step of preferment in the state, and gave admission into the senate. In this capacity he served under Crassus in the Parthian war; and, upon many occasions, discovered not only his bravery, his great care that provisions and pay should be regularly distributed to the army, the more peculiar duty of his office, but he was also of the most essential service to the general himself, by the advice which he from time to time gave him; and it seems to be the opinion of ancient authors, that, had Crassus been more attentive to his counsel, he might have opposed more successfully that formidable enemy, and might have saved himself and his army from that disgrace with which they were overwhelmed. Upon the death of Crassus, B. C. 53. Cassius succeeded to the command of that shattered fragment of the army which remained after so complete a defeat. At the head of this body of troops he retreated through Syria, and though pursued by the Parthians, the most formidable enemy the Romans ever engaged, he succeeded in fortifying himself in Antioch. In this city he was besieged, but the enemy were unable to dispossess him, and he even obtained a considerable victory over them. In the civil contests that took place between Cæsar and Pompey, and which terminated in the complete subversion of the republic, Cassius warmly espoused the cause of the latter. He had the command of Pompey's navy; but, according to Cæsar, (lib. iii. *de Bell. Civ.*) this was only nominal, for the real command was entrusted to Bibulus. The issue of the battle of Pharsalia, B. C. 48. is well known. The hopes of the Pompeian faction were completely extinguished, and the path to absolute power laid open to Cæsar. Cassius, however, still entertained hopes of successfully opposing the usurper, and for this purpose directed his course with 70 ships to the coast of Asia; but Cæsar had anticipated his design, and Cassius was thus frustrated in the plan he had formed. He therefore declared in favour of his opponent, as he probably was persuaded that opposition was vain. Of his sincerity, strong suspicions may be justly entertained; for when Cæsar, by being created perpetual dictator, actually enjoyed the most arbitrary power that can be conceived, he, together with his relation Brutus, formed the scheme of assassinating the tyrant who had annihilated the liberties of his country. They succeeded in the attempt, and fled from Rome. Cassius joined Brutus at Athens, and having found means to collect a considerable body of troops, he made himself master of the Syrian province which had been assigned to him by Cæsar. Dolabella had been exceedingly desirous to make himself master of Syria, but was under the necessity of retreating to Laodicea. Thither Cassius followed him, and having taken the city, was guilty of the most barbarous excesses. The history of Cassius at this period is intimately connected with that of Rome, we must therefore refer our readers to that article in our work, in which his different expeditions shall be detailed at length In the mean time it may be necessary to remark, that he subdued the Rhodians, and that in the city of Rhodes he committed the greatest atrocities. He put 50 of the principal inhabitants to death, robbed the city of 8000 talents, demanded 500 more, and was guilty of the most rigid exactions throughout the whole of those provinces through which he passed. At Philippi, the united forces of Brutus and Cassius unsuccessfully engaged those of the triumvirs. Of the mode of his death nothing certain is known. He was found dead in his tent B. C. 42. He was a bold, resolute, turbulent man; and the unhappy times in which he lived, strengthened his natural passions. See Brutus; *Plutarch*; and Middleton's *Cicero, &c.*

CASSO, Casos, or Casus, the name of one of the Cyclades islands in the Mediterranean. It is about three leagues in circumference, and is surrounded with several islands of a smaller size. The part of the island which is cultivated is divided into portions, and shared among the inhabitants, who, by great toil and industry, have rendered it surprisingly fertile. Though the ground is stony, yet barley and wheat are raised, and a very good wine is obtained from the vines. The land is sown at the beginning of the rainy season, which continues from October to February, and the crops are cut down in March. Excepting between October and February no rain falls, the air is remarkably pure, and the temperature is rendered delightful by the breezes from the sea. When their services are not required for the purposes of agriculture, the men are engaged in trade with the different islands in the Archipelago, from which they supply the deficiency in the produce of their own island. The women of the island, who wear a jacket, a sash, and a long cotton robe, are principally employed in spinning cotton, or embroidering, and in making the fine linens which form their dress. Poultry, eggs, rice, and wine, are the principal articles of their food. The men dine together seated upon a carpet, and the women have a separate apartment to themselves. The principal amusements are dancing and music. "The population of this island," says Sonnini, "entirely composed of Greeks, is not considerable. The island is little frequented by shipping, its roads being difficult of entrance, and its shore dangerous of access. The inhabitants are but the more happy and free. The Turks seldom venture to go thither, to exercise the despotism with which they overwhelm the countries subject to their empire; and indeed those Greeks of Casso, more independent and more secure in their property, are more laborious than elsewhere." See Savary's *Travels*, and Sonnini's *Travels in Greece and Turkey*, chap x. p. 134. (π)

CASSUPA, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 190; and Humboldt and Bonpland's *Plantæ Æquinoctiales*, fol. p. 43.

CASSYTA, a genus of plants of the class Enneandria, and order Monogynia. See Botany, p. 201.

CASTANEA, a genus of plants of the class Monœcia, and order Polyandria. See Botany, p. 320.

CASTILE, (Old) a province of Spain, lies on the western side of the river Ebro, which, with the mountain of Doca, separate it on the east from Arragon and Navarre. On the north, it is bounded by Asturias and Biscay; on the west, by the kingdom of Leon; and, on the south, it is divided from New Castile by the mountains of Guadarrama. It forms an irregular triangle, of which the western side measures 59 leagues, the north-east 51, and the south-east 53; and comprehends an area of 18,272 square miles. "Old Castile," says Laborde, "presents a succession of plains, or rather one expanse of down, surrounded by lofty mountains, and occasionally intersected by other mountains of equal elevation, and diversified by hills, eminences, and gentle acclivities." Its mountains are merely ramifications from the great Pyrenean ridge, which runs along the northern provinces of Spain as far as the Atlantic, and consist chiefly of the mountains of Burgos, called also the mountains of Santander, the Sierra d'Occa, the Sierra de Gogollos, and the Sierra Piquera. These mountains contain several varieties of marble; and one in particular, which lies between Aspictia and Vidana, is composed entirely of that substance, which is a black marble veined with white. Copper mines are found near d'Escary and Old Colemar; and in the vicinity of the latter place, is a bed of jet, and several muriatic pyrites. A transparent vein of quartz, as fine as rock crystal, and forming a bed of about four inches in breadth, extends nearly half a league from south to north of Mata; and, about two leagues from Guadarrama, another vein of quartz mixed with pyrites, intersects a mountain of granite from one side to the other. The quartz, in this vein, is detached from the rock; and grains of gold are easily distinguishable. Mount Arandillo, which constitutes a part of the mountains of Burgos, is composed entirely of calcareous rock; and, in its centre, exhibits impressions of the large horns of the cornua ammonis, and that species of shells commonly called St James. On the top of the mountain is a thick saline lake, from which salt is procured by evaporation, in the proportion of seven pounds of salt to one quintal of water.

Old Castile abounds with mineral waters. Among its cold springs, are the celebrated lakes so well known by the name of Fuente de Boecio, or Lagos de San Vicente, and Lagos de Santa Casilda; and of its tepid springs, the principal are those of Arnedillo, whose source rises at the foot of the mountain Encineta, about a mile from the town, Barco d'Avila, Banos, which was well known to the Romans, and Alcaraz.

This province is watered by numerous rivers, among which are the Xalon, the Monubles, the Queiles, the Duero, the Carion, the Tormes, the Cayar, the Ebro, the Alhama, the Arevadillo, the Araja, the Lagtera, the Irequa, the Tiron, the Pizuerga, the Zidacos, the Arlanzon, the Arlanza, the Henarez, the Carnoca, the Valtaia, the Abion, the Uzero, the Castillo, the Ducraton, the Burejo, the Nazerilla, the Ora, the Paz, the Tueva, and the Oja. The plains and valleys are fertilized through which they pass, and though the soil is frequently rocky, and scarcely susceptible of culture, yet in some places it is highly favourable for the purposes of agriculture, particularly in the district lying between Rodrigo and Burgos. There the harvests are most luxuriant, and every species of grain is produced in great profusion, and of excellent quality. Cultivation, however, is much neglected throughout the province. The ground is merely scratched with a light plough; but notwithstanding this slight preparation, the heat of the climate, and the dryness of the atmosphere in this country, such is the inherent humidity and richness of the soil, that the crops are seldom known to fail; and so plentiful is the increase, that a third part of the harvest is considered as sufficient for the consumption of the province. It is to this profusion, indeed, that we must, in a great measure, attribute the backwardness of the natives to agricultural improvements. The overplus of their crops, owing to the difficulties of conveyance, can seldom be converted into wealth. Their only method of exportation is on the backs of mules, and the roads are in general so wretched, that some of them are even scarcely practicable to these sure-footed animals. Part of the great road which leads from Bayonne to Madrid, intersects this province, and passes through the cities of Burgos and Valladolid, but the cross roads are no better than they were four centuries ago. They are narrow, steep, and rugged, sometimes miry, and often impassable to horses. The pass of Guadarrama, which is the nearest point of communication between Old and New Castile, was, till about the middle of the last century, so steep and difficult, that it could not be attempted without danger. But by the care and munificence of Ferdinand VI. a road was formed, beginning at the village of Espinar, by which the ascent was rendered safe and easy. In gratitude for this service, a marble monument has been erected to his memory, which represents a lion resting on a column, with this inscription:

FERDINANDVS VI.
Pater Patriæ
Viam utrique Castellæ
Superatis montibus
fecit
Anno Salutis MDCCXLIX
Regni sui IV.

It stands on the summit of the mountain, which is called the Puerto de Guadarrama, and from it the eye can take in at once the whole extent of country included in the sister provinces. The difficulties of exportation, however, in this province, would be almost completely obviated by the completion of the canal of Campos. This work was begun in 1753 by the same prince, and was intended to reach from Fontibre, two leagues from Reynosa, to the river Pizuerga below Valladolid, and then passing by Segovia to join the Duero. But after it had been cut for several miles, it was suddenly stopt, and has never since been resumed, though its accomplishment would require neither extraordinary labour nor expense.

Old Castile produces a considerable quantity of wine, but it is inferior both in strength and flavour to that of the southern provinces. Fruits are in general very scarce, except in the canton of Burela, which is indeed covered with luxuriant orchards, and well wooded with elms, poplars, and chesnuts. But this district is the only one in the province which can boast of such plantations. In the other districts, the appearance of trees is chiefly confined to the banks of the rivers. Many of the extensive plains are almost entirely bare of foliage; and in some places, particularly between Cabezan and Rodrigo, they are not embellished with a single shrub. Madder has of late years become a favourite object of cultivation in this province, and is produced in great quantities in the vicinity of Burgos, Segovia, and Valladolid. It employs more than a hundred mills, and furnishes annually about seven or eight thousand quintals. Wool, however, is the staple commodity of Old Castile, and constitutes an important article of foreign exportation. Innumerable flocks of sheep, which winter in the plains, browze during summer on the mountains, where they find a rich and luxuriant pasture. Their wool is equal in quality to any in Spain, and the cloth of Segovia, into which it is sometimes wrought, is famous throughout Europe. Immense numbers of cows also feed upon these mountains, but such is the ignorance or indolence of the inhabitants, that their produce is turned to very little account; for though this province alone could almost supply excellent salt butter for the whole kingdom, yet it produces little more than what is requisite for its own consumption; and Spain is compelled to draw that necessary article from other countries.

While Old Castile continued to be the residence of its sovereigns, and was animated by their presence, it held the first rank among the provinces of Spain for opulence, as well as for the excellence and variety of its manufactures. But since the removal of the court to Madrid, its prosperity has most rapidly declined. The manufactures of woollen and linen cloths, for which it was formerly so distinguished, are now almost annihilated. The greatest part of its wool is carried to France, where it is fabricated into cloths and caps, many of which return to Spain for sale; and the half of what is manufactured at Segovia is sent to Madrid and some other places in New Castile. Paper, hides, and leather, are also exported to the same province; white glass to Arragon; and a little wine to Biscay. Its imports, however, are more considerable, and consist annually of about 400 quintals of almonds, and 15 quintals of dried figs; 12,000 loads of rice, paper, needles, brass-nails, silks, and oil; 700 quintals of flax, and 12,000 of hemp; 800 pieces of stuff; 720 dozen pairs of worsted stockings; besides saffron, cutlery, salted pilchards, linens, wire, nets, printed calicoes, shoes, and iron utensils.

The character of the inhabitants corresponds with the depressed state of their province; and, according to a late writer, they bear in their swarthy complexion the expression of poverty and dejection.—They appear to have little relish for the pleasures of society, and are more remarkable than any of their countrymen for that gravity and hauteur of manner, which is the general characteristic of their nation. They have scarcely any intercourse with each other, and the few amusements in which they engage are always of a solemn and sombre cast. In their conduct, however, they are honest, temperate, and sincere; "their morals," says M. De Laborde, "are incorrupt and ingenuous; they are upright in conduct, strangers to artifice, and unpractised in cunning or duplicity; they are naturally obliging; probity is their birth-right; and they are so disinterested, and so perfectly free from all affectation, that they may be justly stiled, the honest people of Spain." From this general character there are some exceptions in particular districts. The inhabitants of the valley of Mena, who boast of being descended from the ancient Cantabri, still retain a considerable share of their ancient courage and vivacity; and the mountaineers of Burgos have a great resemblance to those of Biscay, both in habits and manners. The dress of this description of inhabitants is indeed quite peculiar; and that of the women in the villages bordering on the province of Biscay, still exhibits the fashion of the 16th century. It consists commonly of a brown gown, with slashed sleeves, close at the collar and wrist, and bound round the waist with a large girdle and buckle; the hair is braided in tresses, and hangs down behind; and the head is covered with a black silk hat, called a *montera*.

The population of Old Castile scarcely amounts to one half of its former number. It is estimated at present at 1,190,108 persons, among whom are 146,036 nobles, 9013 vicars and secular priests, 8774 monks and nuns, 1865 advocates and writers, 5760 students, and 37,183 domestics.

The principal places in this province are Burgos, the capital and an archbishop's see; the episcopal cities of Osma, Siguenza, Avila, Valladolid, Segovia, Calahorra, and Soria; and the towns of Logrono, Santo Domingo, de la Calzada, Granou, and Acofra. It has three cathedral chapters, twenty-five collegiate chapters, three establishments of the military order, 4555 parishes, 390 religious houses, a superior military government, a captain general, six subordinate military governments, six provincial intendants or comptrollers, a royal chancery, and three universities.

In Old Castile was laid the foundation of the Spanish monarchy. This province was first wrested from the Saracens by the kings of Leon, who annexed it to their dominions, and entrusted its government to a certain number of nobles, who held the rank of counts. Its subjection to Leon, however, was but of short duration; for, in the beginning of the 10th century, the high-spirited Castilians, provoked by the cruelties and oppressions of King Orduno, who had seized and murdered all their governors, renounced their allegiance, and declared themselves independent. Having established a popular form of government, the legislative and executive powers were vested in two judges chosen by the people, until 923, when Fernando Gonzales, one of the judges, was proclaimed sole count of Castile. The succession continued in his family for three generations, when the male line becoming extinct, Nuna Mayor, the great-grand-daughter of Gonzalez, resigned her hereditary right in favour of her husband Sancho, king of Navarre, who, in 1028, assumed the title of king of Castile. The greatest part of New Castile was still occupied by the Moors; and it was not until 1085, that that province was reunited to Old Castile. The descendants of Sancho succeeded to the kingdoms of Leon, Arragon, and Valencia, and the principality of Catalonia; the province of Biscay and a part of Navarre were afterwards annexed to their crown; and they obtained by conquest the Moorish kingdoms of Murcia, Seville, Cordova, and Granada, thus uniting under one dominion the isolated states of the Spanish peninsula. The capital of Old Castile was the seat of the government; and notwithstanding the extension of the empire, it continued to be the royal residence till the 13th century, after which it shared that honour with Toledo, until the beginning of the 16th century, when Charles V. transferred his court to Madrid. See Laborde's *View of Spain*, vol. iii. p. 1—55; and Swinburne's *Travels through Spain*, vol. ii. p. 244—271. (*p*)

CASTILE (New), the largest province of Spain, extending (independent of La Mancha) 56 leagues from north to south, and 49 from east to west. It comprehends the Celtiberia, the land of the Oretani, and the *Carpetania*, &c. of the Romans; and has Old Castile on the north and north west; Arragon, Valencia, and Murcia, on the east and south-east; the Sierra Morena on the south, which separates it from Andalusia; and Estremadura and Leon on the west, from which it is divided by a ridge of hills, called Gaudaloupe, and La Sarena. This province contains about 22,000 square miles, and presents a diversified aspect, consisting of immense plains, intersected by numerous rivers, and divided and surrounded by lofty mountains. The principal range is, that which was called by the Romans Montes Orospedani, and which originates in the Sierra D'Occa. From it the other mountains are merely ramifications, of which the Sierra de Cuenca is the chief, and is supposed to be the most elevated land in Spain. It is of considerable extent, reaching eastward to Arragon and Valencia, and is diversified with many fertile valleys. The Sierra de Molina occupies the north-east point of the province; and the Sierra D'Albarazin, which runs a little north of it, stretches towards the south-east, when it forms a junction with the Sierra de Cuenza. The Sierra de Guadarama, which constitutes the northern boundary of the province, is derived from the Pyrenees.

All of these mountains contain treasures of intelligence, which would amply reward the researches of the mineralogist and botanist. Their recesses are as yet unexplored; and the traveller tramples at every step upon tribes of plants, which, however beautiful and useful, are scarcely known to the natives of Spain. On the mountain of Barbaxeda are a copper mine and a bed of coal; and on a lofty part of the same mountain are the lakes of Tobar and Beteta, which are both above four hundred fathoms in depth. They abound with tench, and are frequented by flocks of teals, wild ducks, and other aquatic birds. Hyacinthine stones are found in their vicinity; and near Maranchon are fragments of pisolites, belemnites, and other bivalved fossil shells, resting on a bed of calcareous earth. At Bonaco de Sierra, about two leagues north of Cuenza, are several kinds of variegated marble, among which are a yellow marble veined with violet, a yellow marble striped with pink, and a marble of a variety of colours; and at the foot of the Guadarama mountains was found a large emerald, which is now employed in polishing mirrors in the glass-house of St Ildefonso. The mountain of Las Contreras contains a salt mine, which is said to have been wrought from the time of the Romans. It is called the salt pit of Minglanilla, and consists of a series of deep caverns, into which the descent is by 200 steps cut in the rock. It gives employment to thirty men, and its produce belongs exclusively to the king.

In the mountains of this province are several curious caves, some of which are evidently the remains of mines long ago forsaken. Those most worthy of notice are in the Sierra de Cuenza, viz. the cave of the Greeks, the iron cave, and the cave of Peter Cotillas. "This last," says Laborde, "is remarkable for the variety and beauty of its congelations, which compose stalactites of every description; to the eye they present striking similitudes of the human figure, of dogs, adders, pyramids, and columns; by the light of torches they are resplendent; some of them, by their transparence, resemble crystal; water is constantly dripping from every part of this cavern, which, in all probability, is the relic of an ancient mine."

Among the abundance of mineral waters in New Castile, the principal cold springs are those of Alameda-Sagra, Vacia-Madrid, Cevica, and Anover, which are all saline, and the two first are highly cathartic. The thermal waters are those of Sacedon, Corcoles, Trillo, and Buendia. Of the principal rivers which run through this province, three are navigable, the Tagus, the Iaco, and the Guadiana; and the smaller ones are, the Henarez, the Gaya, the Cabriel, the Oliana, the Guecaro, the Cauda, the Zuia, the Bedija, the Xiqueta, the Lozoya, the Guadarrama, the Albercho, the Xarama, the Molina, the Manzarana, the Cabrilla, the Tietar, the Tacuna, the Tortoles, the Guazaon, the Guadiera, and the Moscas. This last, which rises in the mountains of Cuenza, and flows from thence to Valera, has its waters impregnated with salt.

These rivers are well adapted for the purposes of irrigation, and might be converted into valuable sources of fertility. The soil, though rich and fertile, is much parched, and requires nothing but moisture to adapt it for every species of agriculture. But the indolence of the inhabitants is a complete bar to all improvement. The rivers are allowed to flow undisturbed in their native channels; and though the beneficial consequences of irrigation in this province were long ago ascertained by Michael Alvarez Ozorio, and it was demonstrated by his son, in 1687, that even the little river of Narez was adequate to the fertilization of 80,000 fanegas of land, yet agriculture still remains in the same state, without any attempt at profiting by such proofs. Many of the cantons, however, are under tolerable cultivation; but others are completely neglected, though capable of great fecundity. Among the former are, the country lying between Guadalaxara and Alcala de Henarez, the district of Torrelaguno, the rich plain of Requena, and the vale of Aranjuez; and among the latter are, the lands commencing on the frontiers of Arragon, and extending for twenty leagues to Torrija; also those between the Bravo and the river Albercho, and the country near Alcorcon, on the road leading from Madrid to Talavera de la Reyna.—Wheat is the staple produce of the province, and indeed, except a little barley, it is the only grain which is cultivated. It yields most abundant crops, wherever its culture is made an object of attention. In the vallies lying beneath the Sierra de Cuenza, and in the environs of Madrid and some other towns, as well as in the plain of Talavera de la Reyna, &c. the harvests are most luxuriant, yet the quantity produced by the whole province is scarcely sufficient for the consumption of the inhabitants. Very little flax is raised here, though the soil is well adapted to its cultivation. Hemp, however, is more plentiful, particularly in Alcaria; and the country of Huete alone produces yearly the average quantity of five or six thousand arobas. Saffron is planted in various parts of New Castile, particularly between Madrid and Cuenza. It is in great demand over all Spain, especially in the Castilian provinces; and consequently it is considered as a profitable object of cultivation. Its consumption, however, in some places, is rather diminished; and the 40 quintals which were formerly produced in Huete are now reduced to five.

The greatest part of the province is equally destitute of foliage with Old Castile. Woods are very rare; and even for several leagues round the capital a tree is scarcely to be seen. An extensive tract of 40 leagues, from Aranjuez to the confines of Valencia, is almost completely bare, without a shrub or leaf to break the naked uniformity. The fertile plain between Guadalaxara and Alcala de Henarez is also devoid of trees; and the country through which the great road leading from Portugal lies is equally naked. "There is not a tree to be seen," says Mr Swinburne, "from the Sierra Morena to Toledo, nor from the banks of the Tagus to Madrid: a few dwarfish evergreen oaks, huddled together in nooks of hills, and some stumpy olive plants, scarce deserve the name of trees." A few particular spots, however, are more favoured. In the plain of Requena, trees are cultivated with considerable care and success; and some of the mountains, particularly those of Cuenza, are clothed with indigenous pines, and various kinds of oak. Poplars are abundant at Talavera de la Reyna; and there are woods of green oak in the environs of Torrija. The banks of the rivers are, in general, embellished with elms, poplars, and willows; and between the village of Flores and the river Henarez, is a forest of the quercus coccifera, producing the precious worm which supplies the carnation tint. Fruit trees are very scarce; and though the soil, with the means of irrigation which they possess, is very favourable for their culture, yet this province draws most of its fruits from Valencia and Arragon. Vines are cultivated in several places; but the wine of New Castile, though good, is often thick, and sometimes hard, and is considered as inferior to that of Arragon and the southern provinces. In some cantons, plantations of olives are both numerous and flourishing, especially between Cebolla and the Guadarrama, and the southern parts of the province. The fruit is excellent, but the oil both of New Castile and Arragon is execrable, owing entirely to the method of preparing it; for were it properly extracted, it would be equal to any in the kingdom. Considerable quantities of honey are gathered in this province; and that of Alcaria and the Sierra de Cuenza is reckoned the best in Spain. On the mountains of Cuenza alone, the produce of 1773 was 3334 arobas of honey, and 156 of wax.

The manufactures of New Castile consist chiefly in woollen stuffs. The cloths of Brihuega are excellent in their quality, but they are surpassed by those of Guadalaxara and Vigonia. Very little linen is made here; and its manufacture is confined almost entirely to Toledo and St Ildefonso, which employ only about 30 looms. Extensive manufactories of silks and gildings, however, are established at Requena, Toledo, and Talavera de la Reyna; where are also fabricated plain and figured velvets, of mixed colours, and embroidered with gold; taffetas, satins, silk serges, silk stuffs, gold and silver stuffs, and silk ribbons. At Requena alone these manufactures give employment to nearly 800 looms, and the annual consumption of the three places is estimated at 100,000 pounds of silk, 4000 merks of silver, and 70 merks of gold. Besides these, the other principal branches of manufacture are, calicoes, laces, and tapestries; silk, cotton, and worsted stockings; hats and caps; porcelain and delf ware; pikes, swords, and cutlery ware. There is also a royal manufactory for mirrors, which was carried on at the king's expense. Most of its manufactures, however, are scarcely adequate to the demands of the province; and it is indebted to other districts for many articles of comfort and luxury, of ornament and use. A few of its stuffs are carried to Seville and Cadiz, and thence exported to America; but its cloths and woollens are inferior to those of England and France, and cannot stand in the same market. Its silks, which are exposed to sale at Madrid, are also undersold by the French silks, as well as by those of Catalonia and Valencia.

Considerable improvements have been recently made on the roads of this province, which have greatly facilitated the transportation of goods between the different districts. Some of these roads are broad and handsome, but almost universally incommoded with dust. They are sometimes planted with trees on each side, and are frequently intersected by rivers, over which are several well constructed and magnificent bridges. Many of the cross roads, however, are still scarcely passable, being rough, narrow, and often dangerous.

Though New Castile is the residence of the court, and comprises within itself every thing calculated to produce opulence and splendour, a fertile soil and a salubrious climate, yet its general characteristics are poverty and ignorance. Industry, science, and the liberal arts, are confined entirely to the capital, where they flourish under the influence and protection of the sovereign. But the traveller has scarcely left the city, when he finds himself transported, as it were, to a different region. The luxury, wealth, and activity of Madrid emit not one ray beyond its walls, to cheer the poverty and sloth with which it is surrounded. While the capital is fostered by the hand of power, the province is left to languish in indigence and obscurity. The means of instruction are denied to the majority of the inhabitants, and but niggardly supplied to others. The universities of Toledo, Alcala de Henarez, and Siguenza, are (excepting those of the capital) the only public institutions in the province for the advancement of literature. The mechanical arts are equally neglected; and there is scarcely a native of New Castile who is distinguished as an artisan. Those of the capital are either foreigners or Catalonians; and among the literati are to be found fewer Castilians than the natives of other provinces. It is not, however, the want of capacity which renders the Castilian inferior in these respects to the other inhabitants of the peninsula, but rather a native indolence arising from habit, and the want of sufficient encouragements to exertion. He still retains the prejudices of his warlike ancestors, who, devoted entirely to the exercise of arms, looked upon agriculture and the arts as ignoble and inferior objects; and though the arts of peace have been long established in many of the other provinces of the kingdom, the prejudices of the Castilian has been perpetuated by indolence and the scarcity of instruction "With superior capacities for reflection," says Laborde, "the Castilian thinks much, but demonstrates little, and acts less; he is rather slow in yielding his confidence, but when he trusts at all, it is with his whole heart and soul; he is neither prompt in enterprize, nor disposed to acquire the regular habits of industry. There are perhaps not many active occupations he is likely to pursue with success; his aptitudes are to science, particularly to such abstruser branches as are connected with speculation and research; his conceptions are strong and vigorous; his judgment solid; his imagination vivid and vivacious; he devotes himself completely to the objects of his pursuit, but he is seldom capable of embracing more than one at the same moment; his genius only requires culture and encouragement; but he possesses not the power to obtain knowledge, and the government fails to afford him the means of instruction."—"The New Castilian," says the same author, "possesses qualities of genuine excellence; he is honourable and humane, sober and temperate, and revolts from every species of falsehood and duplicity. In his temper he is more docile than the native of Old Castile, who pertinaciously retains the inflexibility of his ancestors, whilst the other readily assimilates with the character of the neighbouring provinces. In general, the observer may trace in him a complexional resemblance to the country he approximates; he is most civilized in the environs of Madrid; most useful in the borders of Andalusia; most active and industrious on the confines of Valencia; most arrogant and rude on the frontiers of Arragon and the Sierra de Cuenza; most indolent in the neighbourhood of Estremadura; whilst generosity, nobleness, and benevolence, are the bonds which unite him to Old Castile. In particular, we should select for praise the inhabitants of Alcaria, distinguished by their frankness and simplicity, their cheerful love of labour, their social affections, and ready hospitality." The steady loyalty, the decorous gravity of deportment, the cautious prudence, and the fortitude in adversity, which have distinguished his forefathers for many centuries, still distinguish the Castilian of the present day. The frequent revolts in Catalonia lead him to characterize the Catalonian as a rebel, and to cherish against him a deep-rooted hatred; while the sentiment is repaid on the part of the Catalonian with contempt. On the promenade, while others are walking backwards and forwards, the Castilian takes his seat on one of the benches, and never rises but to return home.

Some of the towns and districts of this province are distinguished by local customs and amusements, as the *mondas* of Talavera de la Reyna, the festival of the nights of Prado, the mass of Aginaldo, and the custom of burning Judas in effigy. The guitar is their favourite instrument; but the pandero and zambomba are also much in use, and are peculiar to Castile; the former is generally accompanied with sequidillas, and the latter with the voice, but is used only from All-Saints day to Christmas. The music of both is harsh and monotonous. Of the national dances, which constitute a principal amusement of the Castilians, the quaracha is peculiar to themselves. It is danced by a single person to the sound of the guitar, and the steps are formal and precise, greatly resembling the Dutch minuet.

The population of New Castile bears no proportion to its extent; and according to Laborde, has been sensibly diminishing during the last century. Of many flourishing villages, scarcely a vestige remains; and 195 deserted chapels perpetuate the names of as many once populous hamlets, which have been long left without an inhabitant. According to the estimates of 1787 and 1788, the total inhabitants of the province, without including the monks, amounted to 940,649, among whom were reckoned 5443 priests, 8794 monks and nuns, 12,687 nobles, 2123 advocates and writers, 2859 students, and 46,742 domestics.

New Castile has two Cathedral chapters, five collegiate chapters, two abbeys, four establishments of military orders, 1301 parishes, 375 religious houses, 108 hospitals, eight monks hospitals, a supreme military government, four provincial military governments, four provincial intendants, three universities, fifty schools, six cities, 754 towns, and 382 villages. Its chief places are Madrid, Toledo, Cuenza, Talavera de la Reyna, Illescas, Zurita, Tremblequa, Villa Nueva de los Infantes, Consuegra, Alcolea, Guadalaxara, and Alcala de Henares.

This province, early in the fifth century, was conquered from the Romans by Altholphus, king of the Alani, who fixed his residence at Toledo, and laid the foundation of a Gothic dynasty, which lasted for 300 years, and ended with Roderigo, who fell in the battle of Xeres in 711, when opposing the invasion of the Moors. This battle was followed by the subversion and desolation of the Gothic empire; and this province continued under the subjection of these intruders till its reunion with Old Castile in the 11th century. See *Old* CASTILE, and SPAIN. See also Laborde's *View of Spain*, vol. iii. p. 56—324; and Swinburne's *Travels through Spain*, vol. ii. p. 114—243. (*p*)

CASTILLA, a genus of plants of the class Polygamia, and order Monœcia. See BOTANY, p. 337.

CASTILLEIA, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 242.

CASTLE, an edifice designed for defence against hostile assault.

The state of military architecture is, in every country, strictly commensurate with the advancement of the arts. We can trace its regular progression from the condition of the defenceless savage, who shuns his more powerful enemy by retreating to the fastnesses of the mountains, down to the construction of towers and battlements which the most skillful engineer can devise for the repulsion of the assailant, who has all the destructive engines of war at command. Nevertheless this is a subject which has experienced uncommon neglect, and the elucidations it receives we are compelled to give from scanty materials and the memorials of former ages.

When mankind, in savage life, begin to manifest inimical designs against each other, the weaker retire to eminences of the earth; they pile bulwarks around them, or form earthen circumvallations, and rows of pallisades. Their bulwarks, as civilization improves, are converted into rude constructed towers; after which are erected edifices gradually enlarging into castles, and lastly appearing in spacious areas, encircled by buildings, serving alike for convenience and defence. That such are the different gradations, is not only testified by modern experience, but by ancient history, and in particular by that of our native islands.

One of the simplest kinds of regular entrenchment that can now be found, is among those South American Indians, who are just verging towards the first degrees of civilization. Retiring to the top of a hill, they dig three or four ranges of moats around it, each strengthened by a parapet, from whence they can safely annoy an assailing enemy. Sometimes the exterior circumvallation exceeds a league in circuit; the inner parapet or bank is always higher than the outer one, and their dwellings stand in the centre of the whole. Not very dissimilar from this, was the custom of our ancestors during the Roman invasion soon after the birth of Christ. Tacitus, in speaking of the resistance offered to Ostorius, says, *tunc montibus arduis et si qua clementer accedi poterant, in modum valli saxa præstruit;* that is, they secured themselves on rugged mountains, and defended any accessible parts by ramparts of stones. The remains of such an entrenchment, now called Moel Arthur, exist on the top of a mountain in Wales. On the only accessible side void of precipices are two ditches of great depth, with corresponding ramparts guarding the approach, and the summit has been levelled into a smooth terrace, where the natives assembled, or like the South American Indians, dwelt in their huts. The black and white *Catter Thun* in Scotland, so distinguished, it is said, from their different colours, are also ranked among the earliest means of defence adopted in that country. Both of these, from the advantage of position, are of great strength, and crown the summit of two hills. The black *Catter Thun* is of a circular form, consisting of various concentric earthen ramparts, from one side of which issues a rivulet that has made a deep gully in its descent to the level ground. Perhaps the black catter thun is of somewhat more laboured construction; it is of an oval figure, consisting of a stupendous dyke of loose white stones, whose convexity from side to side is 122 feet. It encloses a flat area of ground, 436 feet long, by 200 in breadth, which was consequently either the site of a considerable number of edifices, or received a large body of men. The whole outside is encircled by a cavity resulting from the disposition of the stones. Two deep ditches, of which only vestiges of the second remain, encircle this ancient post, one at the base of the mound of stones, and the other about an hundred yards lower. Foundations of small circular and rectangular buildings are yet perceptible, as also the site of the well. Other entrenchments, apparently of the same kind, are seen in different parts of Scotland; and analogous to the catter thun, is the celebrated circumvallation, now called the Herefordshire Beacon, situated on the highest of the Malvern hills. Here the summit is of an oblong irregular figure, 175 feet long by 110 in breadth, quite level, and surrounded by a high steep rampart of stones and earth, and a very deep ditch. Lower down the hill are two irregular areas stretching east and west, each defended by a high bank and deep ditch, and ramparts still further down contributed to complete the system of defence.

Varieties are found in the construction of the simple fortifications, in lofty places where greater labour has promoted the convenience of the defenders. One situated on a high hill in Wales is protected by three stone walls on the only accessible side; the upper ones 15 feet high, and 16 broad. The space at the top consists of an irregular area, full of small rude mishapen cells, some round, some oval, and of different dimensions. Square or oblong cells are likewise seen; one of the former is at least 30 feet long, and several of the round are not less than 15 in diameter, but such cells are of smaller size in other fortifications.

Successive ditches and ramparts were to be overcome before the assailants could reach the concentrated strength of the defenders. On the top of a high hill in Cornwall is such a fortification, called Caer-bran, surrounded first by a deep ditch, 15 feet wide, edged with stone, through which is a passage to an outer rampart of earth 15 feet high. Within is another great ditch, three times as wide as the former, and then a rude stone wall, completely encircling the summit of the hill.

People, therefore, in the most barbarous ages, found their account in selecting lofty situations for defence, just as the South American Indians practise, and as is witnessed among the islanders of the Pacific Ocean. The latter, we know, establish their fortifications on rocks or promontories washed by the sea, and which are scarcely accessible by land. The path is intercepted by deep ditches and strong pallisades, while the spot chosen on the top of the height will contain but a few huts within its limits. Hence the fortresses of these islands have originated on steep and precipitous rocks, such as Edinburgh, Stirling, and Dumbarton castles, and that of Dunamase in Ireland, besides many others.

Although mankind have usually established themselves on heights, there is one rude kind of edifice found in low grounds in Scotland, which, common consent having denominated the most ancient castle of our forefathers, must not be omitted here; and similar structures are said to exist in foreign countries. These are called Duns, all at this day in ruins, but still exhibiting the general outline of the parts which composed them. Each is the frustum of a cone without, but perfectly circular within, consisting of large flat stones deposited on each other, without mortar or cement. Whether they had any roof, or what was its particular form, is uncertain; but it is conjectured, that they might have been divided into stories, and there is always a door close to the ground. The internal diameter of duns is from 20 to 30 feet, and the walls are of great thickness at the base. Dun Dornadilla is one of the most entire, if a ruin may be called so, that remains; and its admeasurements have frequently been taken by distinguished antiquarians. This ruin is somewhat less than 30 feet in height, though the surrounding rubbish shews that it must have originally been considerably more. Its internal diameter is 27 feet, and its circumference nearly 150. There is no external aperture found here, or in other edifices of the same description, except the door; but towards the inner court are several openings, to transmit light to cavities in the centre of the stone-work. This would lead us to infer, either that such buildings had no roof, or that it was not completely closed at the highest part, if of a conical form. Three successive rows of narrow galleries, or passages above each other, are formed in the thickness of the wall of Dun Dornadilla. They are mutually connected by steps, also within the wall, and lighted from the apertures in the circumference of the inner area. Each gallery is somewhat lower than the height of a man, just wide enough for a passage, and floored with large flat stones, which unite and bind the whole building together. Independent of the apertures, there are other recesses in the wall, which do not penetrate through to the internal galleries. An edifice still more remarkable, called Dunaliscaigh, or Dun-Alishaig, is also seen in Scotland, on the Frith of Dornoch. It is conical, like the others, built of large rough dry stones in equal layers, each of which contracting an inch and a half as the building rises, produces its peculiar figure. Here the diameter is 30 feet, the circumference 164, and the thickness of the wall 12. About nine feet above the ground, a circle of stones projects into the area, broad enough to walk upon; and one step above these, there are four doors which enter into the chambers of the second story, which communicate by stairs with those below. Both the stories of chambers are as the former, in the heart of the wall, and receive light by apertures to the interior; but their figure and disposal are very different. Entering the door of the edifice below, a narrow passage on the right introduces the visitor to a small oval cell, and there is the same to the left. Other three entrances from the internal area, at equal distances, likewise lead to small oval cells of a similar description; therefore, each cavity in the wall consists of two oval cells, connected by a narrow passage, from one side of which an entrance communicates to the court.

Some analogous edifices are of larger dimensions, enclosing a much greater space within their circuit, and their walls rising to a considerable height. The latter, however, is by no means proportioned to the diameter of the area, so far as we are at this day enabled to judge. A rude constructed building, consisting of dry rough stones without cement, stands on one of the Orkney Islands; the walls of which are still 45 feet in height, though the interior circle does not exceed 20 feet in diameter. The conical shape is continued only about two-thirds of the edifice, and it is thence cylindrical to the top. A stair of steep narrow steps in the heart of the wall, which is sixteen feet thick, leads to the summit of the ruin: and the whole building is encircled by four or five stories of galleries also in the wall, interrupted only by the ascent of the stair. Broad thin stones serve for the roof of one row, and for the flooring of the next; and light is admitted from the court, by three perpendicular rows of small square apertures.

Such edifices are not invariably situated in low grounds; one which has elliptical chambers, like Dun-Alishaig, stands on a precipitous rock, overhanging the river Brora. But they are not less to be considered as places of defence, from being commanded by adjacent eminences. All that their inhabitants had to dread, was probably being within arrow flight, or the range of a spear, both of which are extremely inconsiderable, when precision is to be relied upon. But though we must necessarily ascribe their erection to a period of remote antiquity, it is difficult to conceive by what means their uncivilized tenants would accomplish it. The doors are in general such as we at present use; but the lintel of some consists of a huge triangular stone, six feet long in each side, and four in thickness. Nay, it is said, that part of the wall of one is composed of a stone 29 feet long and 9 feet thick. We are thus minute in describing these very ancient edifices, as they exhibit remarkable peculiarities, and because an evident similarity pervades the whole, indicating a common origin from the same people.

It is not probable that the pillar towers found in Scotland and Ireland, and also we believe on the continent, were designed for military purposes; yet intelligent persons have maintained a different opinion. Thus we shall only remark, that they were of great height, extremely slender, and of skilful architecture. Some are 90, 100, even 130 feet high, though not exceeding 15 in diameter at the base. The door is always at a considerable height above the ground, sometimes 8, 10, or 15 feet, and without any remaining communication or means of ascent. We shall afterwards see, that one great precaution in constructing castles, was placing the entrance far above the ground.

It cannot be supposed, that our ancestors remained insensible of the advantages which the regular entrenchments and fortifications of their Roman invaders afforded, and possibly might combine them with their own national modes of defence. Single fortresses, in all countries, naturally arise in place of simple mounds or bulwarks; and those which were thrown up for temporary use, at length became so many encircling walls of strong materials, which could afford protracted resistance to a foe. Sometimes the Romans erected temporary towers on the verge of their encampments during their progress through an enemy's country; and if their operations were to be permanent, these were constructed of stone.

On ascending to an early period, we find an interesting specimen of ancient fortification, far exceeding that of the Scotish duns, in Launceston castle, Cornwall. The remains of a central tower stand on the top of a conical hill, which are of a circular shape, 18 feet of internal diameter, with walls 10 feet thick. About the distance of six feet from the exterior, this tower is encircled by a wall 12 feet thick, lower than its top. After another interval of six feet, is a second encircling wall; beyond which is a third, or breast-work, now in ruins. A circular wall is said likewise to have surrounded the base of the hill, which is judged to be above 70 yards in diameter; and still further off, one more, fortified by towers, and guarded by a ditch on the outside. The area occupied by the three concentric structures on the top of the hill, is about 31 yards in diameter. Some antiquarians date the formation of this edifice anterior to the Roman invasion of Britain: whatever may be the truth in this respect, the difficulty of an enemy surmounting the successive entrenchments can easily be conceived.

In foreign countries, either exposed to hostile invasion or liable to intestine commotion, there are castles constructed on a similar plan. Indeed, we may here remark, that there is scarcely any exclusive or peculiar fashion adopted by one nation which is not at some ancient or modern æra seen in another. Rocks, islands, and precipitous heights washed by the sea, have always been favourite situations. The Mingrelian princes in Asia dwell in strong towers, thirty or forty feet high, which are encircled by a second wall of stone. We are likewise told of the fortress of Irivan in Persia, built on the verge of a steep precipice, and surrounded by three walls. The ancient and modern castles, that is, those which exist in modern times, for we cannot tell the precise date of their æra, are protected by similar means of defence. Herodotus describes Ecbatana in Media, as being built on a lofty hill, and surrounded by seven walls. All these were of different colours, and each exceeded the height of that adjacent to it. Within the central inclosure was the residence of the king. It has been argued that Launceston castle in Cornwall, was perhaps built after some design introduced from the East, by those nations frequenting the British coast in quest of tin. This, however, is not a necessary conclusion, because the varieties in fortification in the same country are conspicuously displayed, according to the prevailing sentiments of the people respecting their capacities of resistance. Thus we see round or square towers standing single or combined, encircled by walls or moats, or destitute of both; small, capacious, low or lofty, all as chosen by individuals diverging from common rules, or adopting improvements. But irregularities so numerous and so great are exhibited, that we can scarcely reduce the different edifices under any certain classification. Our attention shall chiefly be directed to the castles of this and the neighbouring island.

Mr King has appropriated the erection of British castles to nine successive æras. 1st, The small strong Anglo-Saxon tower, one remove from the northern dun; 2d, The large and improved castles of Alfred; 3d, The round Norman keeps, on high artificial mounts; 4th, The beautiful towers of Gundulph about the time of the conquest; 5th, Mixed buildings, where architects were not restrained by any fixed principles; 6th, The magnificent piles of Edward I. derived from foreign countries, uniting the accommodations of a palace with the strength of a castle; 7th, Palaces as completed by Edward III. absorbing the military architecture of castles; 8th, Spacious mansions for residence, and embattled only for the purpose of ornament; 9th, Palaces properly so called. These he considers as including "all the regular successive alterations from rude barbarity to civilization."

Instead of illustrating the peculiarities of these different fortifications, we shall confine ourselves to some miscellaneous observations on several fortresses with whose structure we are acquainted, and on the means of defence.

The castles with which this island abounded, were, in general, erected by individuals; but we are told they were originally so few in number, that an invading enemy was enabled to over-run the country. From passages in the life of Alfred, it has been inferred that he built only wooden towers; and it has been concluded, that castles walled with stone, designed both for residence and defence, are not of greater antiquity than the conquest. Then it is affirmed by our older historians, that the whole kingdom was harassed with building castles by command of the sovereign; and the turbulent condition of the succeeding reigns contributed to increase them more and more. They served as well for a receptacle to the lawless, as a protection for the orderly part of the communit ty; but from the powers usurped by the rude and ignorant owners, they at length became the residence of so many petty tyrants. Stephen is reported to have encouraged the erection of castles in the earlier part of his reign, and no less than 1115 were built before its close, so that the face of the country was entirely covered with them. However, the licentious conduct of those who inhabited them becoming intolerable, a treaty was entered into with Henry Duke of Normandy, whereby all constructed within a certain period should be destroyed. Many were therefore rased to the ground, and subjects were prohibited to erect others without special licence. Probably the means of obtaining the royal permission was not of difficult attainment, and in the subsequent reigns, subjects continued to build castles until they came to be no longer considered indispensible to safety.

It has appeared extraordinary to some, that so many castles could be erected in England within so short a time as from the conquest to the end of Stephen's reign; but let us consider what was done in Ireland during the reigns of Elizabeth and James. The former obliged every grantee of forfeited land to build a fort or castle for the protection of his family and tenants, and the stile of fortification was to be proportioned to the extent of his grant. Lord Aubigny having obtained 3000 acres, built a strong castle, 50 feet long by 28 in breadth, five stories high, flanked by four round towers; adjoining to it was another fortification, 50 feet square, flanked by two turrets 15 feet high. This castle stood where five public roads met, and kept the neighbouring country in awe. In a few years one hundred and sixty eight fortifications, great and small, arose in the six northern counties; and it has been calculated that there were, most likely, not fewer than three or four thousand in the whole island.

After all the intermediate stages of military architecture, to which the labours of individuals, or even of uncivilized states, gave birth, we at last find the completion of strong and extensive edifices, artfully constructed, and secured against the warlike assaults of an enterprising enemy.

A large portion of ground, sometimes extending to many acres, was enclosed within the precincts of a castle, which consisted of various important parts. First, the barbican, or watch tower, an advanced post, stood beyond the moat by which the castle was encircled. On the verge of the moat was a wall, called the wall of the outer ballium. A vacant piece of ground, contained between it and another wall, was called that of the inner ballium. Within this second wall were the different edifices appropriated to the garrison; and the citadel, or keep, the main place of refuge and security to the defenders. The walls were strengthened by round or square turrets, properly disposed; and we read of ingenious contrivances, among those of the most ancient construction, for communications among the besieged. The city of Byzantium had seven towers, from one to another of which sound could be transmitted, and in such a manner, that no confusion or interruption ensued. In like manner, we find flues or cavities among the remains of some of the castles of this kingdom, which it is likely were intended for no other purpose.

The barbican, which constituted the sole entrance into the castle, was connected to the moat by a draw-bridge, so that it might fall into the hands of an enemy without great danger to the besieged.

The ditch, which was either wet or dry, was frequently of great breadth and depth: if dry, subterraneous passages from the castle sometimes communicated with it, through which cavalry could issue. Here there was another draw-bridge connected with the external rampart or wall of the outer ballium, which was lofty, flanked with towers, and had an embattled parapet, pierced with chinks, to give a view of the surrounding objects. The entrance to the outer ballium, and also to the inner, was through a strong gate, situated between two towers, and rendered yet more secure by a ponderous portcullis, sliding like a window sash in a groove of the wall. It was not one gate only which protected the garrison; two, or even three, single or double, are seen in ancient castles, each with its iron portcullis: all which had to be forced before access could be gained to the interior.

The keep, or dungeon, which our modern poets absurdly call the *donjon*, in imitation of the barbarous French of ancient times, frequently, and perhaps most properly, stood in the centre of the whole structure, on an eminence. But its place was by no means uniform; and it is very often situated at an angle of the enclosure, or sometimes at one side. Its figure was round, square, or polygonal; its height and diameter indefinite. The walls were always of great strength, even eighteen or twenty feet thick; it was guarded by a moat, and its entrance was through a machicolated gate, that is, where there were gratings or apertures above, through which melted lead or scalding water could be poured on the assailants, or heavy weights, that could be retracted by chains, employed to crush them below.

In vulgar acceptation, the keep is now understood to be the place formerly devoted to the confinement of prisoners alone, and that it was invariably a subterraneous dungeon: but, on the contrary, it was always a lofty tower, and the residence of the principal persons of the castle. We know not whence the name of dungeon originates, but we cannot coincide in the conjecture of those antiquarians, who think it is from the scanty light received through the narrow apertures of thick walls. If the keep was small, a single apartment occupied each story; in large castles, it was a round or square tower of four or five stories, each containing more than one apartment, with turrets at the angles of the latter, in which were stairs. Frequently in the centre of the ground floor there was a well of terrific depth; and there were also frightful vaults below for the reception of prisoners. The stories were divided by strong arches or simple flooring, and the summit was usually crowned by a platform and embattled parapet, whence the garrison could descry the approach of their enemies. To prevent the access of missile weapons, the only windows were narrow loop holes, or long chinks in the wall, which in itself was of such thickness, as to admit of chambers or stairs in its substance.

Very great varieties, however, are exhibited by the keeps of successive ages, or perhaps of the same; and considering it as the ultimate place of refuge to the besieged, we cannot be surprised that their utmost skill and efforts were lavished on its structure. All single towers unconnected with walls or circumvallations, come under the general name of keep, for in fact a keep is nothing but a tower. Strength was more the object than convenience; and if in any situations the accommodation of the defender was studied, it was in such a way that the security of the castle might not be endangered. Thus, in the lower stories, nothing but long narrow loops and oillets admit the light; and where there are windows, they are cautiously placed so high as to be beyond the hazard of projectiles, or if one should enter, it will strike the interior arch in the substance of the wall. There are instances where the loop is contrived obliquely inclining downwards, so that if a missile weapon entered, instead of reaching the interior of a chamber, it was conducted up to the roof beside the loop itself, on which its force was spent.

The keep of Coningsburgh castle in Yorkshire is of remote antiquity, and has been ascribed by several antiquarians to the fourth or fifth century. It rises from a low mount at one angle of the area that formerly constituted the whole castle. From the surface of the mound, the diameter of the tower gradually decreases until about 18 feet in height, where there is an entrance by a flight of steep narrow steps to the interior. The tower then rises perpendicularly to the height of 80 or 90 feet from the ground. Its figure is cylindrical; but six massy buttresses project eight feet from the sides, exhibiting an unusual style of architecture. The tower is of small diameter, there being only a single apartment at the entrance 21 feet wide, lighted by loop holes. In the centre is a circular aperture, through which is seen a dismal dungeon below, which no one has yet had resolution to explore. But this being generally the site of the well, possibly a spring exists at the bottom. In the thickness of the wall, which is fifteen feet, there is a broad stair, lighted by two loop holes, and in another part also in the thickness of the wall, are chambers, one of which is of a hexagonal form, the roof 15 or 16 feet high, and resting on pillars. The keep of Carisbrook castle is circular: its internal diameter is 21 feet, and it is likewise strengthened with buttresses. Like the former, it rests on a mound, and the entrance is above, by a steep flight of 50 steps from a covered way. At the bottom of the keep is a dungeon, and near the centre a well, said to have originally been 300 feet deep. Belonging to the same castle is another tower, with a well still 210 feet in depth. Nothing was of equal consequence to the besieged as a constant supply of water; hence particular care was observed to choose the site of the keep above a spring; and such are almost always found on digging out the ruins far under the surface. Sometimes the well was on the outside of the foundation, and so enclosed within a tower, rising of equal height with the keep, through which water could be drawn up to the top of the castle.

Instead of the small towers which formed the keep of Carisbrook or Coningsburgh Castle, the analogy between which and the pillar towers in Scotland and Ireland, so far as respects the height of the entrance above the ground, cannot be overlooked, there are large square or circular structures in other places of defence, designed for the same purpose. The tower of Canterbury Castle is nearly a square, being 88 feet by 80, and some are much larger. Mr King, who has bestowed much attention on the subject of ancient castles, considers the castle of Rochester as one of the most perfect for defence; but our limits preclude us from shewing in detail the means by which that was attained. Here the chief tower is nearly square, like the preceding, being 75 feet by 72: and what the architect, according to that author, has had in view and accomplished, was, 1. To provide for the security of the entrance. 2. To protect the garrison after capture of the out-works, and preserve to them the power of annoying the enemy. 3. To mislead the besiegers, by drawing their attacks to the strongest part of the buildings. 4. To secure the stores, and also the prisoners, by an inconsiderable guard. 5. To convey the great engines of war into the different apartments with facility, and also to the top of the tower. 6 The means of speedily alarming the whole garrison, without apprizing the enemy. 7. Supplying the castle with water. 8. Discharging the smoke, and formation of the drains. 9. Providing a safe and commodious habitation for the governor of the castle.

The disposal of the two ballia was not invariably encircling the castle; for there are examples of one at each of two sides, as in Dunamase in Ireland: neither was the dungeon for confinement of prisoners always under the principal tower. The walls of Cockermouth Castle in Cumberland form nearly a square, about 600 yards in compass, flanked by several square towers. Within are two courts; and on each side of the gate entering into the second are two deep dungeons, vaulted at the top, and with a small opening, through which the prisoners were lowered down: two narrow slits, level with the ground, admitted the provisions, light, and air. Each dungeon is capable of containing 50 persons. Such dungeons were sometimes in the vestibule of the entrance into the tower; but little regard was paid to the conveniences of those unfortunate captives, who fell into the hands of their enemies; and numerous examples are recorded of their being starved to death from mere negligence.

Castles, large or small, enclosing courts within their precincts, are common throughout the island, and at the same time exhibit great irregularity of structure. The castle of Kildrummy, in the north of Scotland, was of a pentagonal form, and defended at each angle by a strong and lofty tower: the remains of one is still judged to be 50 yards in height. It contains a spacious court, exceeding an English acre in size; and there are indications of a subterraneous passage, for communicating with a deep glen below, through which, it is affirmed, both men and horses could reach a stream flowing in its centre. Before the use of cannon, this place is said to have been thought impregnable.

Enlarging the extent of castles admitted of an irregular assemblage of buildings, and as the successive owners attended to both convenience and defence, their alterations and additions frequently exhibit a confused, and sometimes an unsightly pile. Many were so spacious as to have churches or chapels, we believe even monasteries, attached to them, and great halls were fitted up for the hospitable entertainment of retainers, or dependents on the proprietor. The great hall of Naworth castle, which is a large square pile, surrounding a court fortified by square towers and battlements, is an hundred feet in length. In Raby castle, which is an extensive irregular edifice, with square towers, built in 1378, is a hall nearly of equal dimensions with the former, in which 700 knights, who were vassals of the family owning it, are said to have assembled: and, as is well known, the unfortunate Queen Mary, by a cruel sentence of the English court, was beheaded in the great hall of Fotheringhay castle.

The ancient castles of Britain and Ireland, and in most parts of the continent, were built of stone and lime; but the latter, by mixture with water, was reduced almost to a fluid state, and uncommon quantities poured into the walls. A strong and durable bulwark was thus produced, which the lapse of succeeding centuries is required to impair.

The walls of the spacious castles built by the Moors are formed of mortar only, and entirely without stones. Having undergone the necessary preparation, the mortar is rammed hard into moulds, first for a foundation; when this is done the moulds are removed, and receive another supply, which is also allowed to harden; and by successively shifting the moulds higher and higher, the wall gradually rises, and by the quality of the mortar, and the influence of the sun, becomes as hard and durable as stone.

Block houses, or wooden towers, were also frequently erected, though rather for temporary use than permanent fortifications; nor is the use of them unknown in modern times.

The style of the ancient castle was necessarily such as to be best calculated for defence against the usual engines of war, and the repeated assaults of an enemy. Perhaps a considerable time elapsed before the first invented cannon supplanted the catapulta, mangonel, trebuchet, and warwolf, which were all employed to discharge enormous stones against the besieged. These machines could throw a weight of two or three hundred pounds; and an instance is related where a certain general being displeased with the purport of a mission from a neighbouring enemy, loaded his engine with the messenger, and threw him within the lines. While showers of stones were discharged against the besieged, battering rams were forcibly impelled against the gates, and moveable towers, pushed forward on wheels, enabled the assailants, from different stages, to mount the walls. Fire and mining were both employed, and the defenders successively driven from their strongest posts: thus, in four assaults by Henry III. on Bedford castle in 1224, "the barbican was taken by the first, and by the second the outer ballium. The old tower, on the third attack, was thrown down by the miners, whereby with great danger they rendered themselves masters of the inner ballium, through a chink. At the fourth assault the miners set fire to the tower, so that the smoke burst forth, and the walls were rent by broad fissures, which compelled the garrison to surrender." While the attack was going on, the besieged were not idle: the stones projected by the assailants were returned; if the force of the battering ram was directed against the wall, wool packs were interposed; likewise logs of timber were thrown down to crush the enemy, or their machines were destroyed by immense weights falling upon them. While the besiegers attempted to force the gates, burning sand or boiling lead were poured upon their heads; and, if they did succeed, a ponderous portcullis, descending in its frame, opposed their progress.

It was not of less importance in ancient times to individuals, than it is now to a nation, to prevent an enemy from gaining a fortification. The unfortunate defenders were generally put to death, and to an ignominious one, in proportion to the bravery they had displayed in resistance. This horrible custom, practised only by a few modern barbarians, is of ancient date. Joshua, the leader of Israel, murdered his captives in cold blood. Alexander the Great having besieged Arimazes, a soldier who had established himself on a mountain, with 30,000 men, gained the strongest posts above his enemy. Arimazes offered to surrender, on condition that his own and his followers lives should be spared; but the victorious monarch rejected terms of capitulation. Therefore Arimazes having descended with his relatives and chief men, Alexander cruelly scourged them, and then crucified them at the foot of the hill. Mankind are too sanguinary to shun such examples; and there are repeated instances, as at Bedford, Rochester, and many other places, where the vanquished garrison were promiscuously hanged by their ferocious conquerors.

Where petty states are confined within narrow limits, an uncommon number of warlike edifices will always be found, both to guard against internal divisions, from which unsettled governments are never free, and to serve as a security against mutual invasions. But from the prevalence of the feudal system in these kingdoms, they were alike the protection of the tyrannical overlord, and the unprincipled marauder, who subsisted by the booty acquired from his defenceless neighbours. A savage herd of retainers was sometimes kept, to enable the lawless owner to resist his native sovereign, or to aid him in wanton oppression of his own vassals, or those of others. Invested with absolute powers and privileges, he could with impunity condemn an offender, real or imaginary, to a dungeon, or even inflict a capital sentence upon him; and it was judged an act of clemency, if his resentment extended only to suspension of the culprit a few hours by the heels, instead of by the neck, on a gibbet. If remote from the seat of administration, as in Ireland, where the people are still in an uncivilized state, or in the northern parts of Scotland, it was scarcely within the power of government to root out the turbulent chieftains. No sooner were hostile measures manifested against him, than his whole clan, by one common voice, arose, and formed of themselves an army for his defence: he retreated to the fastnesses of the hills, or fortified himself in his castle in some wild and inaccessible quarter, where he bid defiance to his assailants.

From the total change in warlike operations, the abolition of the feudal system, and the greater civilization of this island, the castles in the hands of private individuals have gradually been allowed to decay. A long protracted interval of internal peace renders them unnecessary to the crown, and the watchful eye of the police guards the safety of the subject, without his seeking places of refuge. Those that still remain, are rather calculated for ostentation than defence. We should therefore view the bulwarks that surrounded our ancestors with double interest, and felicitate ourselves on existing in times, when they are no longer required for our personal security.

See Asser *de rebus Gestis Alfredi*. Matthew Paris, *Historia Angliæ*. Gesta Regis Stephani, *apud Duchene*, p. 934. Radulfus de Diceto, *apud Twysden* and Gale *Scriptores Angliæ*. *Archæologia*, v. 4, 6, 9, 10. Borlase's *Account of Cornwall*. Wright's *Louthiana*. Cordiner's *Antiquities and Scenery of Scotland*. Cordiner's *Remarkable Ruins*. Pennant's *Tour in Wales; in Scotland; Journey from Chester to London*. Grose's *Antiquities of England; Scotland; Ireland*. Ledwich's *Antiquities of Ireland*. King's *Munimenta Antiqua*. (c)

CASTLETOWN. See Derbyshire.

CASTLETOWN. See Man, Isle of.

CASTRAMETATION. See Fortification.

CASTRATION. See Surgery.

CASTRIES, Bay of. See Tartary, and La Perouse's *Voyage*, vol. ii.

CASTS. These are impressions, figures, or statues, formed of plaster of Paris, sulphur, metals, or other substances.

Sculptures of every description are so tedious and expensive, that a more speedy and economical method is adopted, of obtaining resemblances in plaster of Paris. This is attended with the convenience of the materials being easily procured in a state of preparation for immediate use as an impalpable powder; and nothing more is required than an addition of water to reduce it to the consistence of thin paste or cream.

A mould is always necessary for a cast, in whatever substance it is made, and it is formed according to the nature or figure of the subject. In taking a cast from a medal, for example, it is to be laid on a smooth surface, and encircled by a hoop of card or paper, of the breadth desired for the thickness of the mould. The plaster, reduced to the consistence of thick cream, is then to be poured over the medal, and allowed to dry. Thus a mould is formed, which is hollow, to receive the cast. Its surface must be brushed over with a camel-hair pencil, dipped in olive-oil; observing if there are any holes, previously to fill them up by a similar expedient, with thin plaster, which will also prevent holes in the cast. The mould is next to be surrounded with a card or paper hoop, as broad as the thickness of the cast, and the plaster, reduced almost to a fluid, poured in. By allowing it to dry, the cast is formed, and many successive casts may be obtained from the same mould.

If the subject be larger than a medal, we must use a wooden frame, within which the subject is laid, as a certain degree of strength is necessary to resist the pressure of the fluid plaster. It is essential to observe, that immediately after being reduced to the proper consistence, the plaster must be poured on the subject, as by standing it becomes unfit for use.

This, however, is a method adapted only to the most simple impressions, and where none but one side or surface is to be taken off. If there are several surfaces, the mould must be divided into such a number of parts as circumstances may require. Supposing a cast of a round or angular subject is desired, the plaster must not be reduced nearly to fluidity as before, but to the consistence of paste. This is to be applied by the hand as a coating on the subject, and slightly pressed, so as to be adapted to all its different parts, and then cut through in several places with a very thin-edged knife. After being of such consistency as to retain the impression, the pieces are allowed to become completely dry, having, previous to the division, received various pencil marks, that they may be more easily united for the cast. Considerable dexterity is necessary in dividing the pieces of the mould asunder, and in properly adapting them for the cast they are to receive. After being completely dried, they are to be well greased and united, and the plaster, as before, reduced almost to a fluid state, poured in so as to fill the whole cavity. The mould is then taken off, and the cast appears.

Large casts are generally hollow, both to be lighter and to save the materials. In that case, a wooden core is suspended within the mould, with the thicker end outwards, so as to be more easily withdrawn. If the cavity be of an irregular figure, the core may consist of clay, also suspended within the mould by cross wires, or otherwise, and afterwards picked out by a sharp pointed or hooked implement.

In casting a bas-relief from wax, or to obtain another cast of the same substance, the figure desired is first to be modelled on wood or glass, and being surrounded by a frame, plaster is poured over it. This is allowed to dry, and when removed, serves to receive the cast. If dipped in water, and suddenly withdrawn, the wax poured in will not adhere, and comes out quite clean.

Delicate and beautiful casts are obtained in sulphur, which, of late years especially, has been successfully employed to preserve representations of the most elegant sculptures of antiquity. The mould for a cast of this description being formed of plaster, is repeatedly dipped into half a pint of boiled lintseed oil, mixed with an ounce of spirit of turpentine, by which the surface is hardened. A quantity of sulphur being melted in an iron ladle over the fire, and allowed to flame for five or six minutes, is taken off, and after cooling a little, is poured into the mould; and the cast having stood a few minutes, may be taken out. Adding a third part of vermilion, and stirring the mixture well together, will produce a cast of a fine red colour. When the cast is taken from the mould, it should receive a polish, from being rubbed over with clean cotton.

Small metallic casts were easily obtained from moulds of plaster, clay, or sand, the latter of which are preferable for those of larger size. In all cases, particular care must be observed to have the mould perfectly dry, otherwise the cast will be disfigured by blow-holes or pores, and the safety of the artist endangered by explosions, from the rarefaction of the fluids remaining unexpelled. Yet as very few casts of considerable size are to be obtained free of blow holes, these must necessarily be filled up, either by screwing in a portion of the same substance, or beating it in. The latter is the better method, as the interstice is more completely filled up; but instead of simply filling up the pore in the cast taken from the mould, the defect is more completely cured, by enlarging it somewhat more, and then beating in a piece of metal. If the cast has to undergo a considerable change after coming from the mould, it should be beat over the whole surface with a hammer of a few ounces weight, which will close all the small blow-holes, and fit it for receiving a suitable polish. This method cannot be adopted where a complete and perfect figure from the mould is desired.

Equal quantities of pumice-stone and plaster of Paris, with a third of clay, is considered a suitable composition for moulds to receive small metallic casts; or two parts of fine brick-dust, added to four of plaster, and mixed up with water until of the consistence of cream. Supposing a small animal, a bird, frog, or lizard, is to be imitated, the subject, after being moistened with spirit of wine, is to be suspended by threads, in a trough or frame, which must then be filled with the composition. But a channel to the cavity which the subject occupies must be preserved by a strong thick wire, proceeding from its extremities, to above the surface of the composition. This, when withdrawn, will leave a conduit for receiving the metal. Other vents are necessary, in all moulds, large or small, for allowing the included air to escape. The subject thus remaining included, and the wires being withdrawn, the mould must be gradually exposed to successive degrees of heat, until becoming red hot, whereby the subject will be totally consumed, and a cavity left, corresponding to the space occupied by its parts. But as some particles of dust or ashes may remain after every precaution to discharge them, the cavity should be filled with mercury, by which means they will rise on the surface, and may be poured out along with it. The mould, when converted to use, must be rendered very hot, and gently struck after receiving the metal, that access may be gained to all its parts, and the expulsion of air facilitated. After being allowed a sufficient time to cool, the cast is removed.

Metallic casts of large subjects, are great and important works, wherein the concurrence of many different circumstances are essential to the success of the artist. The ancients were well acquainted with the various methods practised in casting in bronze, as appears from the beautiful relics still preserved to us, and the description of the busts and statues of divinities in their temples. It has been conjectured, however, that none of them were of extraordinary size; that they were in general little if any larger than life, and that the colossus, celebrated as one of the wonders of the world, could only have been formed of plates of metal. Some of the moderns have peculiarly excelled in this branch of the arts, and have themselves minutely laid down the rules whereby to obtain a successful metallic cast.

Here, as in all other cases, a model of the cast is built on a skeleton, composed of wood or iron, exhibiting the angles and curvatures of the figures desired. The famous artist, Benvenuto Cellini, affirms, that this skeleton should be covered, to nearly the size of the figure, with clay, well beaten together with a quantity of rags, by an iron rod, and the mixture thus kept several months to macerate. It will then form a paste, which may be wrought up with the hand, and is fashioned into shape. When sufficiently baked, and having been allowed a considerable time to dry, that no contraction may ensue on subsequent heat, this rude resemblance of what is to be cast is covered with a coating of wax, not less than an inch thick, on which the artist impresses the exact form of what the cast is meant to exhibit, and varnishes over the surface. A mould is next prepared of plaster, or of a mixture of clay and sand, which it is exceedingly difficult to procure of suitable quality, and from this cause the works of skilful statuaries have failed; and being applied around the model, is allowed to become perfectly dry. This mould, it is evident, is to receive the cast, but a different proceeding from taking it to pieces is employed to obtain a cavity. It is perforated by innumerable channels through the clay to the surface of the model, which also are all filled up with wax. The greater the number, the more is the chance of success.

When the model is thus completed, and surrounded by the mould, it is lowered down into a pit, by means of a crane, and a brick wall, capable of resisting considerable pressure, built around it. There it is exposed to a moderate degree of heat, by which the waxen coating is melted from within the mould, and runs off by conduits, but, at the same time, leaves the interior surface corresponding with the outline which it occupied. For a statue larger than life, two days and nights are required for the operation, during which time it is necessary that the heat be moderate, otherwise the wax might boil up against the mould and injure it, though the varnish contributed to render it smooth and equal. It is likewise necessary that the pit be somewhat deeper than the height of the figure, in order that the metal may rise above it, and avoid the imperfections which would otherwise arise.

All the previous preparations being completed, a brisk fire is kept up in the furnace, and the metal reduced to a state of perfect fusion, the channel of communication is opened, and it begins to flow. The numerous conduits introduce it to the interior of the mould, and the space before occupied by the wax is speedily filled. After the cast has stood a day or two to cool, the mould is taken off, and it is elevated from the pit by a crane, when it appears altogether covered by spines. These are the metal which filled the channels of communication; and by their removal, and the subsequent polish, the work is brought to perfection.

It has been maintained, that the ancients were such masters of this branch of casting, that they could take figures from the mould free of spines, and so clean and perfect, as not to require finishing by the chisel or the file. But this has been denied by the most intelligent among the moderns, and certainly it would be granting the artist a wonderful degree of skill to suppose it the case.

Casts of all different shapes and sizes may be obtained by practising this method in detail. Some statues weigh one or two thousand pounds or more, according to the size and thickness of the metal. One of Louis XIV. at Paris, weighing above 60,000 pounds, was obtained from a single mass of fused metal which flowed fifty feet between the furnace and the mould. See Dossie's *Handmaid to the Arts;* and Benvenuto Cellini *Due Trattati dove veggono infiniti segreti nel Gettare le Figure di Bronzo.* (*c*)

CASTS, Indian, denote the four grand tribes, or orders, into which population has been divided from the remotest antiquity. The Hindoo records afford no authentic documents to ascertain the origin of this singular arrangement; and the earliest Greek authors who treat of the history of India, content themselves with mentioning the fact without attempting an explanation of its origin. The information of the Greeks does not seem to have been very correct on this subject; for Strabo, Diodorus Siculus, and Adrian, affirm, that the Hindoos were divided into seven casts, or classes: their mistake has probably arisen from confounding with the casts, the various employments allotted to different classes in the community, and from which they are strictly forbidden by the Hindoo laws to depart. No fact is more clearly ascertained, than that there never have existed but four casts in India. The first, or that of the *Bramins*, (see Brachmans,) was deemed the most sacred; and the members of it, had it for their province to study the principles of religion, to perform its functions, and to cultivate the sciences. They were the priests, instructors, and philosophers of the nation. The members of the second order, (the *Ketri*,) were intrusted with the government and defence of the state. In peace they were its rulers and magistrates; in war they were the generals, who commanded its armies, and the soldiers who fought its battles. The third, (the *Byse*,) was composed of husbandmen and merchants, and the fourth, (or *Soodra*,) of artisans, labourers, and servants.

When any person has been guilty of egregrious misconduct, such as neglecting or violating the precepts of his religion, he then becomes an outcast from his tribe, and is subjected to a species of excommunication, which brings along with it the most terrible consequences. The persons thus excommunicated are denominated *Pariars*, and sometimes *Chandalas*, and their condition is inconceivably wretched. "No person of any cast will have the least communication with them. If a pariar approach a nayr, *i. e.* a warrior of high cast, on the Malabar coast, he may put him to death with impunity. Water or milk are considered as defiled even by their shadow passing over them, and cannot be used until they are purified. It is almost impossible for words to express the sensation of vileness that the name of pariar or chandala conveys to the mind of a Hindoo." Robertson's *Disquisition concerning India: Appendix.*

Though it is impossible to fix the period when this division into casts took place, yet it is easy to conceive the circumstances under which it has originated. It must have been established at a time when the regal and sacerdotal offices were united in the same individual; for nothing but the sacredness attached, in early ages, to the priestly character, combined with absolute authority on the part of the person who was thus revered, could have given birth to such a monstrous institution, so contrary to reason, and so subversive of the natural rights of man. This evidently carries back the origin of the institution into the remotest antiquity; for it was only in the primitive ages of the world that this formidable union of regal and sacerdotal power existed in the person of the same individual. When once the division into casts was established, we need not be surprised at its continuance. The human mind needs a stimulus to excite it to any efforts of excellence; and when this stimulus is not only withheld, but positive discouragements applied, we can only expect the mind to remain in a state of torpor and lasting immaturity. This effect has been produced to a very great extent on the immense population of India. The mind being chained down to some grovelling employment, above which it is forbidden to aspire, must seek comfort from dismissing even the consciousness of exertion, and the desire of improvement: and the favoured few, who are permitted to explore the sources of knowledge, being secure of respect, altogether independent of their abilities or attainments, have but little inducement to pursue the rugged paths of science.

By the numerous subdivisions into what may be called professional classes (for every individual is bound by the law to follow the profession of his ancestors,) a considerable degree of perfection in the mere mechanical operations of art may be expected. In this respect the Hindoos have made some approach to that minute division of labour which has had so much influence in promoting the success of the arts and manufactures in civilized countries. But none of these pleasing associations occur to the mind on contemplating the perfection of Indian workmanship, which never fail to present themselves on considering the improvement of the arts in other countries. In the latter case, the proficiency of the artist is in general an indication of enlargement of understanding, and of scientific attainments; in the former, it is rather a proof of mental degradation, when we consider that mechanical dexterity in the arts has arisen from the restriction of the faculties to one minute point, beyond which they are not permitted to wander, and in which they have attained perfection by expending all their energies in one unconnected object.

Dr Robertson having inadvertently said in his *Disquisition concerning India*, that "what now is in India, always was there, and is likely still to continue;" some writers have set to work to confute him, without doing him the justice to acknowledge that he himself has corrected the assertion in a note, and admitted that very considerable changes have taken place in Hindoo customs and manners. We are happy to have it in our power to state, that the influence of the pernicious system of casts which has so long prevailed in India, is almost daily diminishing, and in many cases is scarcely felt. This is so contrary to what has been so frequently asserted on the subject, that it is necessary for us to produce our authority, which we hope will appear decided and unexceptionable. We quote from Mr Colebrook's *Remarks on the Husbandry, &c. of Bengal;* a gentleman who was long a provincial judge in India, and who is well known for the accuracy of his information on every subject connected with the customs and literature of India. "They (the Hindoos) are, as it is well known, divided into four grand classes; but the three first of them are much less numerous than the Soodra. The aggregate of Bramins, Ketri, and Byse,* may amount at the most to a fifth of the population; and even these are not absolutely restricted to their own appointed occupations. Commerce and agriculture are universally permitted: and under the general designation of servants of the other three tribes, the Soodras seem to be allowed to prosecute any manufacture. In this tribe are included not only the true Soodras, but also the several casts whose origin is ascribed to the promiscuous intercourse of the four classes. To these also their several occupations were assigned: but neither are they restricted by rigorous injunctions to their own appointed occupations. For any person unable to procure a subsistence by the exercise of his own profession, may earn a livelihood in the calling of a subordinate cast, within certain limits in the scale of relative precedence assigned to each; and no forfeiture is now incurred by his intruding into a superior profession. It was, indeed, the duty of the Hindoo magistrate to restrain the encroachments of inferior tribes on the occupations of superior casts; but under a foreign government this restraint has no existence. In practice, little attention is paid to the limitations to which we have here alluded: daily observation shows even Bramins exercising the menial profession of a Soodra. We are aware, that every cast forms itself into clubs or lodges, consisting of the several individuals of that cast, residing within a small distance; and that these clubs, or lodges, govern themselves by particular rules and customs, or by-laws. But though some restrictions and limitations, not founded on religious prejudices, are found among their by-laws; it may be received as a general maxim, that the occupation, appointed for each tribe, is entitled merely to a preference. Every profession, with few exceptions, is open to every description of persons; and the discouragement arising from religious prejudices, is not greater than what exists in Great Britain, from the effects of municipal and corporation laws."—"If these facts and observations be not considered as a conclusive refutation of the unfounded assertion made on this subject, we must appeal to the experience of every gentleman who may have resided in the provinces of Bengal, whether a change of occupation and profession does not *frequently* and *indefinitely* occur? Whether Bramins are not employed in the most servile offices? and whether the Soodra is not seen elevated to situations of respectability and importance? In short, whether the assertion above quoted, (respecting the influence of the casts in preventing improvement in commerce and agriculture,) be not altogether without foundation." *Remarks on the Husbandry, &c. of Bengal*, p. 171.

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* We have here departed, for the sake of uniformity, from the mode of spelling adopted by our author: and should be glad to have some specific rule for the orthography of Indian words.

From this passage it will appear that another assertion made by Dr Robertson, and by almost all other writers on Indian casts, is without foundation. He says in the Appendix to his *Disquisition*, "though the line of separation be so drawn, as to render the ascent from an inferior to a higher cast absolutely impossible, and it would be regarded as a most enormous impiety, if one in a lower order should presume to perform any function belonging to those of a superior cast; yet in certain cases the pundits declare it to be lawful for persons of a high class to exercise some of the occupations allotted to a class below their own, without losing their cast by doing so." This is so far from being the case, that *no forfeiture is incurred by intruding into a superior profession*, and the Soodra is permitted to prosecute any manufacture, under the designation of servant to the superior casts, by which he frequently rises to wealth and eminence; whilst the lazy Bramin, who rests satisfied with his divine indefeasible right to pre-eminence, sinks into poverty and merited contempt.

The institution of casts, and the restriction to particular professions, have always been regarded as the chief obstacles to the improvement of India. From what we have stated, however, it does not appear that they are so formidable as is generally apprehended. The natives themselves find it impracticable to observe these restrictions; the inconvenience of which is so great, and their absurdity so glaring, that the only wonder is, that they have maintained their ground so long. Our European settlers, however, and those in particular who have at present the greatest power in India, have uniformly acted as if it were essential to the safety of their government to uphold the present system of degradation and superstition. The three superior casts, the Bramins, Ketri, and Byse, scarcely amount, when taken together, to a fifth part of the population; and yet for the sake of these, the great mass of the people must be doomed to perpetual ignorance and servitude. This certainly is monstrous; but it is the natural system of despotism which founds obedience, as well as devotion, in ignorance. We cannot hope to see these evils remedied, till Britain, or whatever other foreign power obtains the dominion of India, finds it expedient to cherish other views respecting it than those of gain: but in the present state of things, it is found more convenient to employ the established engine of superstition, than to communicate liberty and happiness to so many millions of the human race. (*g*)

CASUARINA, a genus of plants of the class Monœcia, and order Monandria. See Botany, p. 314.

CATACOMBS, are subterraneous galleries and chambers appropriated for the reception of the dead.

Most nations emerging from barbarity have testified a pious anxiety respecting the disposal of their dead, and have erected monuments to perpetuate their remembrance. Some, instead of at once committing bodies to the earth, where they might return to their pristine dust, have deposited them in natural caves, or formed artificial excavations below the surface, where they might be preserved entire from decay. Such was the practice of the Egyptians, which led to the construction of catacombs; and more recently, the Guanches, or aborigines of the Canary islands, adopted an easier expedient of depositing their dead in caves, where three or four hundred bodies may be seen collected together.

The most ancient catacombs with which we are acquainted, are those of the Theban kings; as they can be traced during a period of 3000 or 4000 years. In the age of Diodorus, long after the city of Thebes itself was destroyed, it appears that 17 of 47, the original number, still remained; and Strabo also speaks of about 40 sepulchres of the Theban kings.

The Egyptians, believing that if the human body could be kept entire, it would be revisited by the soul, contrived, by means of embalming, to preserve it from decay. Then it was deposited in catacombs excavated in the earth, to await the return of the animating principle. Hence resulted those wonderfully extensive and intricate subterraneous galleries and chambers which have remained to the present day.

Excavations are always found in the vicinity of the most extensive cities; and they are also seen in remote and sequestered places. But those of Thebes, from the reputed splendour of the city, have been viewed with peculiar interest during many succeeding ages.

The whole chain of mountains in the neighbourhood of Thebes is penetrated for almost three-fourths of their height, by an incredible number of openings, leading to an immense labyrinth of catacombs. Those of the kings, of which the same number can probably still be recognised as described by Diodorus, occupy a deep ravine, flanked by the bed of a torrent, in the centre of the mountain Lybicus. They are between six and seven thousand paces from the banks of the river Nile, and were gained by an artificial passage.

Proceeding along the valley, the traveller unexpectedly discovers openings in the ground, with a gate-way in a simple square frame; an ellipse bearing a beetle, or the figure of a man with a hawk's head, is seen in the upper part, and beyond its edge two figures kneeling in the act of adoration. Each gateway in the valley is an introduction to a gallery, leading to the royal sepulchre. At the distance of forty paces within is another gateway, opening to a second gallery, as broad as the first, and 24 feet in length; and to the right and left of these galleries are small chambers. A third gallery succeeds, communicating with a chamber 18 feet square, above the level of the other apartments; from it is an entrance to a gallery, which, added to a subsequent one, is 64 paces in length. At their extremity is a corridor of 16 paces, leading to a chamber eleven paces square, connected by a short gallery to another chamber of the same size. The royal sarcophagus is next seen, in a spacious saloon twenty feet square. But beyond this is even another chamber, of still larger dimensions. Hence the intricacy of such subterraneous passages may be conceived, the total length of the excavation here spoken of being 225 paces. It is not to be understood, however, that all the catacombs of the kings are of the same dimensions, as equal opportunities have been wanting to ascertain the fact.

The whole sarcophagi have long ago been violated, and the bodies of the kings carried away or destroyed. But their enormous size, and the rugged way through which they were necessarily conducted, must excite our admiration. One consists of a huge mass of granite, 16 feet long, six broad, and eight high. The lid is also a single block of stone, bearing the effigy of a king. The sarcophagus has been worked in the place which it now occupies; which would seem to add to the difficulty, already incredible, of conveyance over the mountains, and along the passages below. But the ancient inhabitants of that territory had always some stupendous work in view, and which it would require ages of our comparatively feeble faculties to accomplish.

Though all the royal sepulchres have been violated, the French traveller, M. Denon, found the fragment of a mummy in one, and also an ancient patera. We believe that nothing besides has for ages been discovered here, which shews how carefully the later Egyptians, or more modern Arabs, have ransacked them.

The whole extent of catacombs is covered with hieroglyphics and paintings, generally in fresco, of the most fantastic figures, from which the grotesque of the Romans is supposed to have been derived. But the preservation of these figures is wonderful, considering how probable it is, that four thousand years may have elapsed since their execution. The paintings were as fresh, to all appearance, as on the day when they were executed, in eight lately visited, except in two places where they were injured by the access of rain. It is said that the Romans endeavoured to remove one of the royal sarcophagi from its site, and levelled the ground below it, to facilitate their undertaking.

The other catacombs in the same chain of mountains are usually on a similar plan, especially those conjectured to have been appropriated for the poor. From an opening towards the east, a passage about 20 feet long proceeds in a straight line, or turns off at an angle, supported by pillars or pilasters. At the extremity of this gallery is a pit from 40 to 60 feet deep, communicating with long subterraneous passages, rudely shapen in the rock, which terminate in a chamber about 30 feet square.

The catacombs of the more opulent ranks of the ancient Thebans, or their immediate successors, were lower on the mountain. In proportion as the height of the excavation increases, they are more richly decorated: the colours of the paintings are brilliant, and the sculptures elegant and well defined. Among the innumerable subjects displayed throughout the catacombs, one chamber is devoted to warlike weapons, another to the implements of husbandry, or a representation of agricultural operations. All ordinary occupations or amusements are exhibited; hunting, fishing, trafficking, and the like. Yellow figures are executed on a blue ground in the royal catacombs, with as much taste as modern edifices would require. Headless trunks are seen; black men who had suffered decollation, and also their executioners holding a sword coloured red. Sometimes religious or funereal processions are exhibited, sometimes games or imaginary subjects. The most singular and apparently absurd figures are displayed. Those of men larger than life, or dwindling to a pigmy size, men with the heads of birds or beasts, or asses raised on their hind legs. It has been conjectured, that the history of each of the ancient Egyptians deposited in the catacombs may be traced on the walls, and that the paintings represent their occupations in life.

Mummies are still found in the Theban catacombs, not in niches, but resting on beds formed entirely of small images of baked earth. They are swathed up, and lie in regular order on the ground. Almost the whole of these cemeteries have been rifled of their contents, either in search of treasure, or for the sake of obtaining the resin with which the head and belly of the mummies are filled. Hence the passages are obstructed by heaps of bones and decaying fragments of mortality, and it is rarely that an entire mummy is discovered. Nevertheless there are still some, such as those just mentioned, which until lately were undisturbed; and on removing the bands in which they were swathed, some rolls of the ancient papyrus, in good preservation, were found. The nails both of the hands and feet are gilt in many mummies, and sometimes two rolls are seen, which are supposed to contain a certain form or order of prayers for the deceased.

A mountain in the neighbourhood of the ancient Eilethia, is also penetrated by numerous catacombs, the entrance to each of which is guarded by two figures armed with clubs, in the sides of an arch which forms the gateway. In one of these recesses are statues of men and women as large as life. But it is chiefly by paintings, as before, that the walls are ornamented; and while the different operations of life are performed, persons are always present, apparently recording them in writing. Here are seen men harnessed to draw the plough, bird-catching, vessels under sail, and the performance of music. The larger human figures are about eighteen inches high, the smaller only eight. The men are painted red, and their clothing is a girdle encircling the waist, which falls to the knees: the women are painted yellow, and are attired in a tunic reaching from the bosom to the ancles. The children are naked.

From the anxiety with which mummies were sought by European nations, the Arabs have made a kind of property of catacombs, and frequently prevent the access of the curious; or practising an imposture on them, a mummy is secretly conveyed to a well known catacomb, and the deluded traveller taught to believe that he is its original discoverer.

Next to the Egyptian catacombs, the most extensive with which the moderns are acquainted are those of ancient Rome. Though their antiquity perhaps is not equal to that of some others dispersed throughout the world, an unusual interest is excited by their containing the remains of a people, who had rendered themselves so illustrious, and whose history is so familiar to our knowledge.

The Roman catacombs are of great extent. Some maintain, that, entering close to the city, they stretch several leagues beyond it; but the precise destination and limits of these, if they actually do exist, are not ascertained. Some others have for centuries been frequently explored: in the course of which a zealous antiquarian, Anthony Bosio, who has amply elucidated this subject, ventured to pass entire days within them, had provisions carried there, and, notwithstanding the danger of the enterprise, traversed their utmost extremities. Yet the hazard of this is great: persons have been known to lose their way; and the passages are of such intricacy, that it is unsafe to penetrate their recesses without a clue.

The catacombs of Rome, like those of most other places, are long, narrow, subterraneous galleries, crossing each other at right angles, or passing off obliquely Chambers at each side occasionally appear, and a glimmering of light is admitted by openings above, distant by intervals of 300 yards or more. But in the interior it is dark as night. The excavations are invariably under the earth, in the puzzolana whereon the city is built: they are necessarily narrow to preserve the roof, and, in some parts, are vaulted. Nevertheless the earth frequently detaches itself from above, and obstructs the passages, or totally blocks them up. There are cavities along each side, which have formerly been appropriated for the reception of lamps; and deep niches penetrate into the walls, wherein the bodies of the deceased were deposited. These niches are invariably in proportion to the size of the individual; those of women and children being smaller than the rest.

The bodies are regularly arranged in one tier of niches above another, along the sides of the galleries, each nich of sufficient capacity according to the number it was required to contain, and closed at the foot by a single brick. In general, the galleries can admit of a man traversing them with facility, and there two or three rows of niches are seen: in some places they are more lofty; and Bosio relates, that one which he discovered was so high, as to receive eight or ten bodies above each other in the sides. Parts of the same gallery, however, were so low, that he had to advance bending downwards, or crawling on his breast, to the different streets and passages; probably the consequence of the superincumbent earth having given way.

The cement by which the tombs are closed, unless where yielding from too great desiccation, is yet entire; and on removing the brick to inspect the interior, the skeletons of the deceased appear in good preservation. In elucidation of this fact, let us quote the words of an adventurous explorer, who recently penetrated these gloomy mansions. "The brick obstructing the aperture of a catacomb being removed, a body, apparently that of a young woman, was discovered. Even yet all the teeth were preserved in her jaws. Here bones were totally covered with stalactites, exhibiting a most singular spectacle; for the light, reflected by the motion of the torches, seemed to animate the body, and the image of the spectator was multiplied a thousand fold, by the most entire portion of the skull."—"Another tomb was opened, wherein a skeleton, turned towards the east, was seen. The hands were crossed on the breast, and but few teeth were in the jaws: it seemed to be that of an old man. When my guide stretched one arm to the head, and the other to the feet, designing to raise the skeleton, it immediately fell into a whitish humid dust. Nothing except the substance of the teeth, which were eleven in number, remained: the whole skeleton had vanished from view." It may here be remarked, that it is proved by numerous instances, while the remainder of the body is utterly decomposed and resolved into the elements, the teeth continue entire, their enamel white and perfect. But though it be also known, that the human hair remains an extraordinary time in preservation, none is seen in the catacombs of Rome. Skeletons are observed there, the hands of which are not crossed on the breast.

The catacombs of Rome, besides the tombs, contain edifices, which, in the days of the most prevalent superstitions, were churches, and where, it is probable, the mysteries of the earlier Christians were celebrated. Many inscriptions are still extant, and elegantly sculptured sarcophagi have been obtained from these catacombs. But above all they abound with paintings in fresco, representing, like those of Egypt, an infinite variety of subjects: and sepulchral lamps, as also vases and lachrymatories, are frequently discovered in tombs which have escaped the pillage of the more barbarous ages.

We shall not here attempt to describe the sarcophagi, as two of beautiful workmanship in Parian marble have occupied the attention of Bosio and other antiquarians: one bearing the name of Junius Bassus, the other that of Probus and Proba, both of the fourth and fifth century. Some others, removed from their original site, now serve for baptismal fonts in Rome. The inscriptions are generally short and expressive; or explain the kind of tomb acquired by the deceased, whether a *bisomus* to contain two bodies, or a *trisomus* for three: and accordingly the bones of two or three individuals are still recognised in several of the niches. These inscriptions are chiefly on black or white marble, some are in gilding, and some painted red. Their grammatical errors, and orthographical peculiarities, have presented great difficulties to a learned member of the academy of Cortona, by whom the catacombs were visited in 1805; but had he referred to the works of Mabillon, to the treatise on the Diplomatic Science by the two Benedictines, and especially to manuscripts of genuine antiquity, his difficulties would have easily been solved. It is chiefly religious subjects that are painted in the catacombs, and these principally in the cubicular or lateral chambers. By religious subjects, we mean those which are taken from scripture history, such as Moses striking the rock, Abraham about to sacrifice his son, or Daniel in the lion's den. Jonas swallowed and vomited by the whale, is a favourite subject. Descending later, Christ is seen amidst the doctors in the temple, or restoring Lazarus to life. But, by a strange association, Orpheus is at the same time depicted with his lyre, and the beasts of the earth flocking around him to listen to his strains. Bosio has particularly specified a painting of the naked bust of a young man of comely appearance. His skin tends to an olive colour, he has large blue eyes and fair hair, a thin scanty beard, and a large nose. On each side, is a full length female figure with a written roll in her hand; and on an arch above him, triumphal cars, drawn by several horses abreast, and driven by charioteers, bearing a palm branch, and a crown or garland. There are besides, figures of victory in the air, and other emblems. Here also, as in the Egyptian catacombs, the common operations of life are represented: funereal repasts, bearing burdens, teams of oxen dragging weights, children gathering fruit, or engaged in puerile sports.

Burnt bones mixed with ashes are found in vases. Glass and earthen vessels, and instruments of torture, have all been recovered from the catacombs.

With respect to the precise æra when these cemeteries were constructed, and the persons for whose reception they were appropriated, we are opposed by many uncertainties. Some ascribe them to the ancient Romans, others bring them to a period about the birth of Christ, and there are not wanting intelligent antiquarians, by whom they are considered as devoted almost solely for a secret deposit of those who suffered martyrdom, while the rage of persecution threatened the extirpation of Christians. It is possible that all the three opinions are right. Though cremation was general among the Romans, we do not learn that it was universally practised: Children were not burnt, nor those in a state of servitude; and besides, if we may credit Pliny, this custom was introduced long after the building of the city. Inscriptions prove, that many who were not Christians were interred here; and numerous emblems, epitaphs, and histories shew, that it was a sepulchre for Christians, among whom were martyrs. The academician of Cortona saw a skull which he conjectured to have been violently separated from the vertebræ of the neck; and Bosio, to whom we have so often referred, relates, that in opening a tomb, he found a skull cleft by a hatchet, still sticking in it, and observed others apparently fractured by violence. It was not uncommon to bury the implement of death or of torture along with the deceased; a custom ascribed to the Jews on interment of malefactors. In another part of the catacombs there was found a horrible kind of pincers, with which the flesh was torn from the bones of martyrs; and also vessels full of concrete blood, which crumbled to earth, but on being wetted immediately shewed its crimson hue. Some of the Roman emperors were deposited in the catacombs of the Vatican. There the body of Honorius was discovered 1144 years subsequent to his decease, with many jewels and ornaments in his tomb, weighing forty pounds of solid gold. It is inferred from a passage in Cicero's Orations, that the catacombs of Rome were not in his time the ordinary places of sepulchre: but it is concluded, that, from the middle of the second century, they were the common cemetry of the city for several hundred years; that the custom was then interrupted, and occasionally revived, as is seen by an inscription on the sarcophagus of Theobald bishop of Ostia, who died in 1158. It appears that some sarcophagi have received bodies for which they were not originally designed, and that inscriptions of far more recent date than the period of interment have been engraven on certain tablets.

It is generally believed, that the catacombs served both as a place of performing their religious mysteries, and for a retreat to the Christians during persecution. Gregory of Tours relates, that two martyrs having been interred in a certain crypt or nich, which was greatly resorted to by Christians on days of festival as a consecrated spot, one of the Roman emperors watched their motions. When the greatest number had collected together, he ordered a wall to be suddenly built against the entrance to the catacombs, and covered by a hill of sand. The miserable devotees were thus condemned to a cruel and inevitable death; but when persecution ceased, and their bones were discovered, the place was held in still greater veneration.

One part of the catacombs is supposed to have been appropriated for the Jews inhabiting Rome. The inscriptions are in Greek, which indeed are frequent throughout the whole recesses; but this is not supposed to invalidate the fact.

Among the various catacombs with which certain parts of the world abound, those of Malta are in the highest preservation. They are cut in the rock, and so white and entire, as to seem just newly executed. The smallness of the galleries, admitting only one person at a time, their nearly equal distribution, circular vaults, niches for lamps for illuminating the passages, and the regularity of the tombs, seem to indicate that they have been purposely excavated.

Regular parallel streets, recesses, and chambers, are seen in the catacombs of Syracuse, the roof of the latter being flat, circular, and vaulted, with a hole at the top to admit light. The tombs, many of which are excavated from solid stone, are ranged around in regular order. Some of these chambers appear to have had a door, by which they could be locked up by their various owners. The door of certain catacombs in Syria and Palestine, is a large thick flat stone, moving on two pivots as hinges.

Catacombs have been devoted not only to receive the mortal remains of the human race, but even the carcasses of the brute creation. Man, ever superstitious and fearful, has sought to propitiate the Deity by the adoration of inanimate plants, of grovelling reptiles, or beasts of the earth. The ancient Egyptians have formed immense excavations, in which to deposit mummies of jackals, mice, crocodiles, birds, and fishes, with as much care as they bestowed on their own friends and relatives. The ibis, in particular, being an object of veneration, has been embalmed in thousands in the extensive catacombs of Memphis. The galleries there divide into many branches, with recesses on each side, about six feet by eight in size, containing rows of baked earthen urns or pots, somewhat of a conical form, all along the walls. In each of these, which is from 12 to 20 inches high, is a mummy of the sacred bird, frequently in perfect preservation, and exhibiting all the original colours of the plumage. The pots are regularly arranged, tier over tier, in regular order.

Almost all catacombs have been violated in search of treasure, and they have sometimes been converted to less pacific purposes than for mansions of the dead. It is not long since a formidable band of robbers was organized in those of Rome, by a Portuguese leader, who, on the day of their admission to his corps, impressed certain mystic characters on the arm of each with a hot iron. They stored up provisions for several months, and have been known to remain above fifteen days unseen in their subterraneous retreats among the tombs. After committing innumerable depredations, their leader having endeavoured to save a Portuguese gentleman who was attacked, some of his party were displeased, and fired upon him: he returned their fire; they fled, and the whole separated, never to meet again. The French, also, during their invasion of Egypt, frequently took up their abode in the catacombs. See *Diodorus Siculus*, lib. i. cap. 4.; Denon *Voyage dans l'Egypte*; Pococke's *Travels*; Norden's *Travels*; Ripaud, *Report of the Commission*; Gregorius *Turonensis de gloria martyram*; Bosio *Roma Sotteranea*. *Voyage dans les Catacombes de Rome*; D'Orville *Sicula*; Houel *Voyage pittoresque*; Mack Gregory *On the Sepulchres of the Ancients*. (c)

CATALOGUES OF STARS. See ASTRONOMY, and STAR.

CATALONIA, a province of Spain. It occupies the nort-east extremity of the peninsula, and is bounded on the north by the Pyrenees, which separate it from France; on the east by the Mediterranean, on the south by Valencia, and by Arragon on the west; extending from east to west about 40 leagues, and 44 from south-west to north-east. This province is almost throughout extremely mountainous, but interspersed with many rich and well-cultivated plains and vallies, which are watered and fertilized by numerous rivers. Its mountains, however, are merely branches of the Pyrenees, which, stretching far into the country, form second-rate mountains, of which the chief are, Mon-Negre, Valgorguina, San-Gran, Alsinellas, Requesens, Monseny, and Montserrat. Of these, Montserrat is the most remarkable, both for its situation, its appearance, and the composition and arrangement of its rocks. It is about 3300 feet above the level of the sea, and appears to stand completely insulated and unconnected with any other mountain, rearing its base and rugged head above a hilly country, like a pile of Gothic spires. Its huge cliffs shoot up to a stupendous elevation, and their blanched and naked summits are split into a variety of shapes. Some of these rocks are composed of limestone of different colours, cemented together by sand and a yellow calcareous earth, and others of freestone and white quartz, mixed with touchstone; indeed, the whole of Montserrat is evidently formed of that species of aggregation, known to naturalists by the name of *pudding-stone*.

Though most of the mountain appears blanched and barren, yet the interstices among the cliffs present the most luxuriant vegetation. These spaces are filled with close wood and deciduous trees, intermingled with aromatic shrubs and flowers, which are nourished by the rich earth which is dissolved, and washed down from the rocks by the rains. The great variety of plants with which these woods abound, would amply satisfy the curiosity of the botanist. There are few evergreens in Europe that may not be found here; and when Mr Swinburne visited Montserrat in 1775, the apothecary of the convent had a list of 437 species of plants, and 40 of trees, which grew in its clefts. There is, however, a great scarcity of water. It is even supposed that there is no spring in the whole mountain; and the streamlets which are sometimes seen to descend from its sides, are said to proceed from reservoirs formed by the rain in the crevices of the rocks, and running in a bed of porous stones that lies across the middle of it. Besides the convent of Monserrat, which is situated in a large cleft on the eastern face of the mountain, there are fifteen hermitages scattered over its surface, some of which are placed on the very pinnacle of the rocks, and in cavities hewn out of the highest cliffs. Between Figueras and Gerona, are two mountains standing together, which are remarkable for their uniformity. They are both of an equal height, and of a pyramidal form; and, according to Mr Bowles, have all the signs of ancient volcanoes. But the greatest curiosity of this province is the mountain of Salt, in the vicinity of Cardona, which is about 500 feet high, without a cleft or crevice, and nearly three miles in circumference. It is composed almost entirely of salt, which is very white, except a small quantity of a reddish and of a bluish cast; and its side, which stands close to the river Cardonero, is nearly perpendicular. Of the substance of this mountain, the inhabitants of Cardona make a variety of articles for sale, such as altars, figures of saints, crosses, chandeliers, salt-cellars, &c. which are as clear as crystal, but cannot be supposed to be equally lasting.

The other mountains of Catalonia contain numerous and valuable minerals. Marbles are found in great variety, and are wrought to a very considerable extent. There are several iron mines near Alins and Taull; lead mines near Tortosa; and of its numerous coal mines, that of Clansa is the best. Amethysts, topazes, and coloured crystals, are found near Vicq, which are manufactured and sold by the goldsmiths of Barcelona, and there are also mines of antimony, copper, tin, alum, vitriol, silver, and one of gold. Among its mineral waters, the most remarkable cold springs are those of Monistrol, Vall de Ebron, Tortosa, and Rivas: and its principal hot springs are at Caldas, Garriga, Gerona, Espluga, and Torello.

Catalonia is watered by twenty-six rivers, of which the chief are the Ebro, which is the largest, and is very important for its navigation, the Segra, the Llobregat, the Cervera, the Fluvia, the Ter, the Muga, the Tordera, the Bezos, and the Noya.

Though the soil of this province be more ungrateful, and more interrupted with mountains and rocks than that of any of the other provinces, yet agriculture is here better understood, and more successfully and universally practised, than in any other part of Spain. The plains and vallies are intersected by numerous canals, for the purposes of irrigation, in which the Catalonians particularly excel, and which is attended with the most beneficial consequences. In some cantons, indeed, this art is carried to very great perfection; and a regular police is established for conducting and distributing the waters. Every proprietor enjoys the right of irrigating his land for a limited time, according to the extent of his property; and for this privilege he pays an annual duty, which is expended in keeping up the canals, and in paying the salaries of the commissioners. The districts most remarkable for fertility and cultivation, are, the country about Lerida, the plains of Urgel, Vallez, and Iqualada; the environs of Cervera, the Campo de Tarragona, and Ampurdan. The industry of the Catalonians, however, is not confined to the plains. The mountains are improved by their skill and labour; and even craggy cliffs, which seem to have been destined for ever to be the habitation of the chamois, are converted by their exertions into vineyards, cultivated fields, and valuable forests. In many places they carry up earth to fix the young vine in, and rather than suffer a good patch of soil to remain useless, they sometimes let one another down from the brow of the rock by ropes. Planting is a favourite improvement, and a principal object of attention with the Catalonian landlords. They vie with each other in multiplying trees of every kind. Plantations of beeches, elms, poplars, pines, and oaks, are consequently numerous and thriving; and cork trees are so plentiful, that Catalonia is able to supply the whole of Europe with this important article. Fruit trees of every description are reared in great abundance, particularly in the beautiful garden on the banks of the Segra, the Llobregat, and the Ampurdan, and between Matavo and Barcelona; and oranges, lemons, figs, almonds, filberts, apples, walnuts, and chesnuts, are common throughout the province. Grain of every kind is raised here, but the crops are liable to frequent burstings and mildew, and the wheat harvest is seldom sufficient for the consumption of the inhabitants, who are obliged to draw supplies from other countries. The cultivation of rice has of late considerably decreased, from the idea that it produces an effect upon the atmosphere very prejudicial to the health; and the people of Ampurdan, who were its first victims, in a moment of irritation, destroyed most of their rice fields. The vintage in Catalonia is, in general, uncommonly plentiful, and the wine in the east part of the province is excellent. That in the west and north parts is rather of an inferior quality. The best red wine is made at Matavo, and the best white at Sitges. Olive trees are in great abundance; but mulberries, though they thrive well, are much neglected; and, consequently, less silk is produced here than in many of the other provinces. The cultivation of flax and hemp is also inconsiderable; and the wool which it produces is altogether insufficient to supply the manufactories of the provinces. The principal productions of Catalonia, with their average annual quantity and price, are contained in the following Table.

Productions.	Quantity.	Value.		
		L.	*s.*	*d.*
Wheat . .	600,000 loads.	912,500	0	0
Rye . . .	120,000 do.	120,000	0	0
Maize . .	22,000 do.	18,333	6	8
Rice . . .	8,000 do.	13,333	6	8
Oil . . .	18,000 do.	60,000	0	0
Wine . .	60,000 do.	51,250	0	0
Brandy . .	35,000 pipes.	262,500	0	0
Walnuts .	35,000 sacks.	35,416	13	4
Silk . . .	200,000 lbs.	100,000	0	0
Wool . .	30,000 quint.	55,000	0	0
Hemp . .	18,000 do.	32,750	0	0
Flax . . .	8,000 do.	16,750	0	0
Cork . . .	33,000 do.	247,875	0	0
	Total . . .	1,925,708	6	8

The roads in this province are in general bad, and notwithstanding the industry of its inhabitants in other respects, they are almost totally neglected. There are very few bridges, and in rainy weather the traveller is liable to be constantly stopped by the rivers, which, in that season, descend in torrents from the mountains. Goods are conveyed in carts drawn by four or five mules, yoked in a line, which carry immense weights; and the Catalans are reckoned the most expert and careful drivers in Spain.

Catalonia, from the remotest times, has been famous for its manufactures; and here every profession that is connected with the useful arts is as much honoured and respected, as in the other provinces it is despised. Its woollen and cotton stuffs, silks, velvets, and linens, were celebrated even in the 13th century; and though its manufactures and commerce afterwards met with several severe checks, and were almost annihilated in the 16th and the beginning of the 18th century, yet from that time their revival has been gradual and constant; and it is now the most active and industrious province in the kingdom. Besides cloths of almost every description, it has manufactures of all kinds of stockings, laces, tapes, nets, ribbons, &c.; also iron ware, cutlery, earthen ware, and shoes, for exportation; and above 200 mills are employed in making paper, which produce annually about 480,000 reams, estimated at 160,000*l.* sterling. These articles, together with its natural productions, supply Catalonia with many valuable exports; and its great extent of coast and excellent harbours, render it peculiarly favourable for an extensive commerce. Its inhabitants have indeed profited by these advantages. The sea-ports are filled with ships, and peopled by traders and seamen, who are equally industrious with their brethren in the interior. Of its coarse cloths and serges, the greatest part is made up into clothing for the troops, and sent to the different provinces of Spain; the fine cloths are carried to Madrid, Arragon, &c. Two thirds of its linens, cotton-velvets, nankeens, and muslins, are exported to the colonies; about one-twelfth and a half is kept for the consumption of the province: and the remaining two-twelfths and a half are sold in the markets of the peninsula. About 10,000 dozen of silk handkerchiefs and sashes, manufactured at Manresa, are annually sent to Arragon, Biscay, and the two Castiles, and 35,000 to America: 30,000 quintals of cork, and 470,000 reams of paper, are exported to different parts of Europe: England receives 20,000 sacks of nuts; 10,000 pipes of brandy are sent to the same place; 4,000 to Guernsey and Alderney, and about 20,000 to Holland and the north of Europe: 8,000 loads of oil are carried to France and Holland, and 4,000 loads of wine to Italy: 200,000 pairs of shoes go to America, and 500,000 are distributed in the interior of the kingdom: and of 24,000 pairs of worsted stockings furnished by the town of Vicq, one half pass into the adjacent provinces. A considerable quantity of silks and silk stockings, are exported to the New World, which also receives fire-arms, iron-ware, printed calicoes, laces, &c. The sweepings of houses, which are shipped annually from Barcelona, amount to nearly 60,000 ducats. The following Table gives an exact account of the quantity and value of its principal exports.

Exported to foreign countries.			Exported to the interior of Spain.	
Commodities.	Quantity.	Value.	Quantity.	Value.
Barcelona linens and cotton stuffs	3,161,000 varas	*L* 295,006 18 4	1,026,041 varas	*L* 82.113 3 4
Manresa silk handkerchiefs . .	35,000 dozen	51,041 13 4	10,000 dozen	14,583 6 8
Nuts	26,000 sacks	26,000 0 0	. . . .	. . . . . .
Oil	8,000 loads	26,666 15 4	. . . .	. . . . . .
Cork	31,200 quint.	233,989 0 10	1,200 quint.	9,000 0 0
Wine	4,000 loads	2,666 13 4	. . . .	. . . . . .
Paper	220,000 reams	73,333 6 8	250,000 reams	83,333 6 8
Brandy	350,000 pipes	262,500 0 0	. . . .	. . . . . .
Shoes	200,000 pair	22,023 15 10	500,000 pair	55,059 10 0
Shoe soles . . .	. . . .	. . . .	. . . .	41,666 13 4
Vicq worsted stockings .	. . . .	. . . .	12,000 pair	500 0 0
Sweepings of houses	. . . .	6,875 0 0	. . . .	. . . . . .
		L 1,000,103 3 8		286.256 0 0
				1,000,103 3 8
			Total exports . . .	*L* 1,286,359 3 8

The imports of this province consist chiefly of corn, wool, and silk. From 400,000 to 600,000 quarters of wheat are supposed to be annually imported from America, Sicily, and the north of Europe; and in 1775 Canada alone sent about 80,000 quarters. It receives 10,000 quintals of wool, and 80,000 lbs. of silk, from Arragon: 100,000 lbs. of silk from Valencia; and Lyons silks, Gange and Nismes silk stockings, fine cloths, linens, essences, perfumes, pomatums, jewellery, and millinery, from France. England furnishes it with superfine cottons, herrings, and cod-fish; and Holland with a few spices. The amount of these, however, is far from being equal to its imports. About 1000 vessels are almost constantly employed in trade, and the government can depend upon 18,000 Catalonian seamen, who are registered, and always ready for any emergency.

The spirit of industry which pervades Catalonia, has led its inhabitants to turn their exertions to the useful rather than to the liberal arts; and, as mechanics, they are in general preferred to those of any other province. The sciences, however, have not been entirely neglected; and among the Catalans have arisen several writers upon natural history, theology, medicine, and law, of no inconsiderable merit. Besides public libraries, and schools of different kinds, there were formerly two academies in this province, under the title of *Gay Science;* one at Barcelona, founded in the end of the 14th century, by John I. King of Arragon; and the other at Tortosa, in the beginning of the 15th, where verses were recited and prizes decreed to the victors. The duration of both, however, was but short; and since their declension, the Catalans have made very little progress in the fine arts; for excepting the works of Volfongona, nothing striking in their poetry is known. In their dispositions, the Catalans seem to be influenced by the nature of their country. They are proud, hardy, and impetuous, of a brown complexion, strong features, and brawny limbs; and their chief characteristics are activity and a spirit of independence. They are indefatigable in the prosecution of their schemes. No obstacles can deter, no dangers can terrify them. Their natural vivacity, their enterprizing spirit, and their love of money, lead them to every quarter of the world; and there are few sea-ports in Europe, India, or Spanish America, where Catalans are not to be found. As soldiers, their bravery and firmness has been always conspicuous, and has been often displayed against the most fearful odds. In the beginning of the 18th century, they withstood the united armies of France and Spain; and, in 1714, the inhabitants of Barcelona made one of the most vigorous and desperate defences that is recorded in history. On a forlorn hope, or for a *coup-de-main*, the Catalans are excellent; but they are in general averse to the strictness of regular discipline. When treated with kindness and mild words, they are docile and obedient; but they rise against the slightest appearance of authority or subordination. The Catalans possess a haughtiness of demeanour, and authoritative tone, peculiar to themselves. They look down upon the rest of their countrymen as their inferiors; the loyal Castilians, in particular, they regard with aversion; and to their ancient enemies, the French, they bear a lasting and invincible animosity. But though high-spirited and overbearing, they are distinguished for their honesty, steadiness, and sobriety. Most of the principal families in Madrid have Catalans at the head of their affairs; and as muleteers and *callessieros*, they are scattered over every province of the peninsula. "The desire of wealth," says Laborde, "makes them industrious; emulation makes them active, leads them to every part of the world, and enables them to brave the perils of long voyages; and glory blinds them to every kind of danger. When they love, they love warmly; but their hatred is implacable, and they have rarely sufficient strength of mind to stifle their resentment. But we are not, therefore, to imagine the Catalan disposed to mischief; he is not so naturally. He works himself into a rage, and is loud, but seldom commits acts of violence. In a political point of view, the Catalan is restless and factious; he is for ever sighing for a liberty, or rather independence, which he has often attempted to acquire, and which has so frequently impelled him to take up arms. But as devoted in his attachment, as terrible in his hatred, he is ready to make every sacrifice for a prince who knows how to gain his love." With all their eagerness for money, the Catalans are capable of the most disinterested generosity; and during the late revolution in France, multitudes of French refugees of all ranks, whose loyalty had driven them from their country, were received, consoled, and protected by the republican Catalans. Instead of the mantle and *Mayo* jacket, common throughout Spain, the usual dress, in almost all ranks among the Catalans, is a close coat in the French fashion, and the peasants on the mountains wear a double-breasted vest, with a kind of wide great coat, called a *gambeto*, which reaches only to the knee. Their ancient and favourite slouched hats, white shoes, and large brown cloaks, were long ago prohibited. Catalonia has a language distinct from the other provinces of Spain. It is the ancient Limousin tongue, but disfigured by hard terminations, and by a sharp and disagreeable pronunciation, which gives an appearance of greater roughness and asperity to the Catalonian character than in reality belongs to it. This language is spoken throughout the province, but with considerable variations in the different districts, and is preferred to the Castilian. It is purest on the mountains, but greatly mixed with Castilian in the large towns. Its harshness, however, is completely lost in the mouth of a Valencian, whose pronunciation renders it soft and harmonious, and though in the towns of Valencia, the Castilian is always used, yet the Limousin in some parts of that province has preserved its ancient purity.

The population of Catalonia since the beginning of the last century has been upon the increase. In 1718, it amounted to 407,132; in 1768, to 722,506; and in 1788, to 814,412, which is nearly its present state. Among these are 6608 priests, 5801 monks and nuns, 1266 nobles, 6968 students, 1020 writers and lawyers, and 20,963 domestics.

Catalonia contains an archbishopric, 7 bishoprics, 8 cathedral and 18 collegiate chapters, 22 abbeys, a grand priory, and 16 commanderies of the order of Malta, 2738 parishes, 284 religious houses, 84 hospitals, a university, fifteen colleges for the education of youth, 14 cities, 283 towns, 1806 villages, 22 fortresses, and five ports. Its principal towns are Barcelona, the capital, Tarragona, Urgel, Lerida, Gerona, Salsona, Vicq, Tortosa, Figueras, Aulot, Igualda, Reus, Mataro, Villa Franca de Panades, Cervera, Manresa, and Palamos.

Catalonia, with the rest of Spain, was overwhelmed by the irruptions of the northern barbarians in the beginning of the fifth century, and continued under the dominion of the Goths until 712, when it was compelled to yield to the Saracens. The Saracen power in this province, however, was not of long continuance; for before the conclusion of the same century, they were completely expelled by Lewis le Debonaire, the son of Charlemagne. It was then erected into a province of France, and was governed by counts or viceroys, removeable at pleasure, until Godfrey or Wifred the *Hairy* was created hereditary count of Barcelona, and the sovereignty of the province bestowed upon him and his heirs for ever. As soon as it became a separate power, it rose to respectability among the independent nations of Europe; and besides Catalonia, the counts of Barcelona comprised under their dominion, Roussillon, Cerdagne, the country of Foix, and a great part of Languedoc. At this time Catalonia was divided into *vigueries* or jurisdictions, each governed by a viguier, or lieutenant, who enjoyed a very considerable authority; and when its count, Raymond V., succeeded to the crown of Arragon in 1137, by his marriage with Petronilla, the heiress of that kingdom, it still continued to be governed by its own states, which shared in the legislative power with the sovereign. These states were composed of the three orders, the clergy, the nobility, and the commons, whose power consisted in proposing to the king such laws as they thought necessary, and in sanctioning those that originated with him. This privilege was continued even after its union with the crown of Spain; but it was gradually undermined by the viceroys, and at last completely withdrawn by Philip V., who allowed them to retain merely the empty right of sending deputies to the states general of the Spanish monarchy. Catalonia, during its union with Arragon, was engaged in repeated, and sometimes lengthened rebellions. It frequently opposed the most obstinate resistance to the commands of its sovereign; and even often attempted to choose a foreign prince as its ruler, or to erect itself into a republic. But notwithstanding its exertions for independence, it continued under the dominion of Arragon, and afterwards of Spain, till 1640, when the Catalans, enraged at the arrest of their deputies at Madrid by the command of Philip IV., flew to arms, and declared themselves free. Being unable, however, long to maintain their freedom, they gave themselves up to France; and in 1641 proclaimed Louis XIII. count of Barcelona. But even the power of Louis was insufficient to support them against Spain. They were reduced in 1652, by Don John of Austria, and in 1659 their submission was confirmed by the treaty of the Pyrenees. The most desperate and obstinate struggle, however, which the Catalans made in defence of their privileges, was in the war of the succession, when attaching themselves to the cause of the Archduke Charles, they resisted every offer of accommodation from the French; and when at last deserted by the king, whom they had chosen, and by every foreign power, they stood alone, and single-hand maintained the contest against the united efforts of Spain and France. By this war the province was drained of its wealth, and almost depopulated, as many of its inhabitants, preferring exile to submission, emigrated to foreign countries. Its manufactures and commerce were destroyed; and when Barcelona capitulated in 1714, Philip V. received a country without resources. Every privilege was abolished, and heavy taxes imposed in order to defray the expences of its reduction. But though depressed and impoverished, it in a short time recovered its activity and energy; and its trade being relieved from the impolitic and paralysing taxes of *alcavala cientos* and *millones*, under which many of the other provinces of the Spanish monarchy labour, it soon rose to its present state of wealth and splendour. Except a few partial insurrections, the Catalans have submitted to the yoke, with sullen apathy; and such is their character of pride and independence, that several of their nobility had constantly refused to accept of any titles and dignities, till the last journey of Charles IV. into this province, who, by his kindness and manners, greatly conciliated its inhabitants. See SPAIN and BARCELONA. See also Laborde's *View of Spain*, vol. i. p. 1—136; Swinburne's *Travels in Spain*, vol. i. p. 16 and 39; and Townsend's *Travels*, vol. iii. (*p*)

CATALPA, a genus of plants of the class Diandria, and order Monogynia. See BOTANY, p. 87.

CATANA. See CATANIA.

CATANANCHE, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See BOTANY, p. 283.

CATANIA, a city in Sicily, the ancient *Catina*, situated in N. Lat. 37° 30′, E. Long. 15° 19′, at the foot of Mount Etna, in the Valley of Noto, one of the three districts into which the island is divided, and on the shore of the Ionian sea.

Whether we consider the political revolutions which this city has experienced, from its earliest history down nearly to the present times, or those awful convulsions of nature which have so often buried it in ruins, Catania must equally attract our notice. In treading upon classic ground, however, it is with regret that we narrow ourselves to the limits which must be observed, lest a subject of particular interest should betray us into a trespass upon other articles, which, though of less moment, must not be omitted. Wherever the earth is inhabited, we find man invariably attached to the spot of his nativity, identifying himself, as it were, with the soil, however few its inducements may be; but the force of the principle is infinitely more striking, where we behold him undismayed by the dangers that perpetually threaten him, constructing his abode of the very lava that had swept away in its course the mansions of his forefathers, upon a foundation that he has often felt shaken by earthquakes, in the midst of surrounding monuments of desolation. Such are the circumstances in which Catania stands. In addition to these, it has undergone every vicissitude to which a city was exposed, from having frequently arrived at sufficient opulence and splendour, to excite the cupidity of barbarians, and the envy of the powerful and ambitious.

Catina, one of the most ancient cities in Sicily, was founded in the time of the Sicanians, who were driven from it by the Siculi, at the period of their landing from Italy, then a Grecian colony, from which they had been expelled. From them Sicily derived the name it still retains. Having established themselves in possession of Catina, they enacted wholesome laws, under which it prospered, until Gero the first of Syracuse, growing envious of their prosperity, and confident in his own power, attacked the city, which he soon sacked. He removed the inhabitants to Leontium, now Leontini, and supplied their places with new settlers from the Peloponnesus. So ambitious was Gero of the reputation of founding cities, that he attempted to abolish the name of Catina, calling that place Etna, and himself a citizen of Etna. His death, which happened in the first year of the 79th Olympiad, afforded a favourable opportunity, which the Sicilians eagerly availed themselves of, to drive the Grecian intruders from their territory. After succeeding in their enterprise, they entreated their countryman Carondas to quit the asylum to which he had fled, in Italy, on the conquest of Catina by Gero, and to return to his native city, to assist them in framing laws for their government; and the result evinced the wisdom of the measure, for Catina again prospered. It next fell a prey to the Carthaginians, who proved themselves the greatest scourge it had hitherto experienced. In the 93d Olympiad, Dionysius, tyrant of Syracuse, obtained possession of Catina, through the perfidy of Archilaus, the prefect of the place. The tyrant plundered the city, and laid it desolate; he sold the inhabitants for slaves, and gave their lands to others.

The Roman yoke was the next which this ill-fated city was destined to feel. While Sicily was a province of the empire, it flourished; but on the decline of that power, it fell a prey to the Saracens: and from the period of their expulsion by Roger the Norman invader, it shared the chequered fortune of the island, until its settlement by treaty upon the second branch of the royal family of Spain, now the only branch of the once powerful house of Bourbon, from whose hands the sceptre has not been wrested.

Catania was laid in ruins by an earthquake in the year 1693; and upon the situation which it occupied, the present city was built, the lava serving at the same time for a foundation as well as a quarry, from which stone was dug for its construction.

Situated upon a declivity, and a level at its base, the aspect of Catania is magnificent and imposing, from the number of public buildings, the width and regularity of the streets, and the size of many of the dwellings of individuals. There are upwards of fifty religious edifices of different descriptions, including churches, convents, and monasteries. The cathedral, dedicated to St Agatha, was founded in the year 1094, and richly endowed by Roger the Norman; but it has often suffered dilapidation from earthquakes, and its appearance is said to be greatly altered from the repairs it has received.

The Benedictine convent of St Nicholas, which occupies a large space in the higher part of the town, is a spacious mass of building, capable of accommodating more than twice the number of its inmates. The size and splendour of the convent bespeak the opulence of their order. Nobility of birth is an indispensible requisite, exacted by the rule of the convent from those who are candidates for a share of its comforts. It is not easy to reconcile this with the profession of a religion, the essential doctrine of which is humility. In the church of the convent there is an exquisite organ, which has been rated inferior only to the celebrated instrument in Antwerp. The museum, occupying one wing of the convent, contains many valuable curiosities, the most interesting of which have been found in Sicily and Italy. As it is within the convent, men only are admitted; but they are readily admitted at suitable hours.

The church, though very splendid, is decorated with paintings of little merit, representing chiefly miracles. In one, St Benedict is seen flying through the air, without the uncanonized appendage of wings, holding in his hand a youth suspended by the hair. The writer of this article was told by one of the brothers, that the boy was a Christian captive, who, lamenting the loss of his religion, prayed fervently to the saint, while discharging the office of cup-bearer to the sultan. Benedict propitiously heard his pious importunities, and quick as lightning descending through the dome of the apartment, seized the boy by his flowing locks, flew off with him, and landed him in safety in his father's house, in as short a time as any magician in the *Arabian Nights* could have done, leaving the Grand Turk in astonishment to lament his *rapti Ganymedis honores*.

In the Sanctum Sanctorum of this church a most precious relic is shewn, which a heretic observer might readily mistake for a rusty fragment of a ten-penny nail; but the miraculous power with which this piece of rusty iron is endowed, irrefragably proved it to be no other than one of the identical nails that pierced our Saviour at the crucifixion. When a stream of molten lava, some years ago, threatened destruction to the convent, the relic was brought from its deposit, and held up in menace to the demon of the lava, which accordingly was immediately turned from its impious course.

One of the breasts of Saint Agatha, the patroness of Catania, is preserved to this day, from the time that she suffered martyrdom in defence of her faith and her honour, at the early age of fourteen; from the shrivelled remains of her, we are entitled to suppose that she was full grown. Many other sacred morsels of saints of both sexes, which, though equally well authenticated, we shall not enumerate, sanctify this place. Narrow streets with lofty houses, has very often been reprobated as an error in the construction of towns in warm climates; the modern Catania, however, shews that the greatest possible inconvenience results from the streets being made very wide, and the houses low. They are so spacious, that the buildings scarcely afford any shade, consequently the heat and glare of light produced by the direct rays of the sun, together with the reflection from the lava, of which both the street and buildings are formed, are intolerable.

The palaces of the nobility are begun upon so magnificent a scale, that few of them are finished. In making this remark, we are forcibly struck with the uniformity of national character, apparent in some circumstances, notwithstanding the changes that have taken place in the government and laws of a country. Plato said, that when a Sicilian sits down to supper, he eats as if he never were to eat again; when he builds a house, he builds as if he never were to die. Had the philosopher lived in the present times, every one must have recognised the likeness of his portrait. We have said *the palaces of the nobility*, because in Sicily no man of rank inhabits a *house*; neither does the country produce what in England is called a gentleman. These palaces are built in a square, with one side to the street; the first upper floors are occupied by the proprietor, for none of the nobility reside upon their estates. They contain large apartments for show, and generally pretty small rooms for use. If a stranger makes his visit at the time of a meal, he will certainly find the family in a small dirty apartment, with pyramids of maccaroni piled before each, upon a tablecloth bearing stains of oil, of an older date than yesterday's supper, attended by squalid lousy servants. The scene is changed on gala days, the spiders are dislodged from gilded apartments, by prescriptive right their own, and the powdered menials are decked out in laced liveries. The lower part of the *palace* forms a striking contrast to an English eye, but it is, nevertheless, in a state of Italian consistency, filth and finery, and silken rags; here coblers and all sorts of mechanics of the lowest orders are to be seen at work in their cells, when driven in by the heat, or on the pavement, when the coolness allows them to breathe a purer air.

Catania is chiefly resorted to by the nobles, whose fortunes do not enable them to shine at the royal residence in Palermo. The city is superabundantly stocked with priests, monks, nuns, and beggars. Any one passing through a Sicilian town, might readily believe that it contained the aggregate of decrepitude and deformity of Europe. The industrious inhabitants are few, the *fruges consumere nati* numerous.

In the square before the cathedral a gigantic elephant, the ancient symbol of Catania, of lava, with an obelisk upon his back, on the sides of which hieroglyphic characters are carved, stands, having withstood the concussions of many earthquakes.

The prince of Biscari, the great man of the place, has a choice collection of specimens of Carthaginian, Grecian, and Roman architecture, mosaic work, and statues; a very perfect collection of Tuscan and other vases, and lamps of infinite variety of form; bronzes, volcanic specimens, and an assortment of cameos and intaglios of the most exquisite workmanship. There are also many excellent monuments of the arts, which have escaped the ravages of time, in iron and other metals, such as pieces of armour, harness, keys, &c. Instead of confining themselves to the display of what they are almost unrivalled in, the vanity of the Biscari family has led them to disfigure their museum, by the introduction of *lusus naturæ*, and disgusting anatomical preparations.

We are told that Catania contains 80,000 souls; but we cannot give them credit for half that number of inhabitants. It is the see of a bishop, much of whose ample revenue is drawn from the snow sold from Etna. There is an university of much repute (in Sicily) in this place, where the three learned professions are taught. The students destined for the church far outnumber those of physic or law, the reason of which is very obvious; nearly one-third of the landed property of the island is in the possession of the church and the religious orders; many temptations are therefore held out: the higher classes, accordingly, very frequently force their daughters, who are not fortunate enough to get married, to take the veil; and as younger sons could not pursue any profession without degrading their illustrious family, they take the vows to obtain a provision for life, and to partake of the good things of this world which the church has to offer. The lower classes flock to those convents which admit people not of noble descent, some from zeal, others to advance in the scale of rank, and many from indolence, to eat the bread of idleness rather than earn it by labour. Of the poorer students for the church, many are educated at the expence of the bishop.

It may amuse such of our readers as are so curious to know the progress of the sciences, to lay before them a few points to illustrate the state of medicine as practised in Sicily; in this view, we shall transcribe some dogmas from the *Institutiones Medicinæ* of the present professor of that science in the university of Catania. "Ungues pedum et digitorum limati, vomitum excitant, (it would indeed be very extraordinary if they did not,) et valent contra epilepsiam, lethargiam, hydropem et intermittentes febres, &c. Urina interne assumpta et recens et tepida ab ℥v. ad ℥vi. matutino tempore, jejumo stomacho viperarum venenum arcet. Urina mariti a parturientibus hausta partum facilem reddit! cum multis de genere hoc!" Such a breakfast, such *siculæ dapes*, would not suit an English stomach.

It may gratify the adherents of that northern light in physic, John Brown, to learn, that their hero has divided the faculty in Sicily into two parties, in each of which, symptoms are to be traced evincing the existence of a malady well known amongst doctors, though undescribed by nosologists, viz. the *odium medicum*, in as genuine a form as ever Germany exhibited. A preliminary to a consultation has more than once been the question, How does opium operate? and we have often read a most excellent application of the true Brunonian answer, written with charcoal in large characters, on the outside of a wine house in the plain of Catania, *Non sedat opium*, followed by the appropriate exclamation, *Viva il celeberrimo Brown.*

How the laws are taught in this university we are not competent to say; but we have seen enough of their administration to form a pretty accurate judgment of their practical application, from which we are inclined to doubt the possibility of the jurisprudence of the petty states of Barbary being upon a worse or more uncertain footing. A very few years ago, two atrocious murders were committed in the course of one week: The bishop's cook was most sacrilegiously stabbed when officiating at his own altar, namely the kitchen dresser; and a travelling guide was shot in the dusk of the evening, at the door of a wine house, by a companion, with whom he had had a dispute the day before. Many examples might be cited, to shew how prone the Sicilians are to commit murder, under the impulse of passion, which is no way restrained by the laws. Although assassination is very frequent, a capital punishment hardly ever is inflicted, and, if it were to take place, the process is so tedious, that the crime would be forgotten before the criminal suffered. We were still more surprised to observe, that the perpetration of two murders in so short a time, called forth no expression of indignation on the part of those whom we may suppose to have been more enlightened, no one even mentioned the circumstance as an extraordinary occurrence; nay more, the police of the place made no effort to apprehend the murderers, because, as one of the senators sagely remarked, "it would be fruitless, for a man always runs off when he assassinates another." Such deeds make no other impression than what arises from the dread of their own career being cut short in the same way.

In digging through the lava some years ago, an extensive theatre of Grecian architecture, built of lava, and founded upon lava, was discovered. There are remains of hot and vapour baths in several places.

The principal exports of this city, are the means of producing heat and cold, the snow and fire wood which Etna furnishes, to Malta and other places; the various sorts of maccaroni, which are well manufactured here, and sold under the general term of paste; silk, which is also manufactured here.

The amusements are, as in every Italian town, a *conversazione*, which much more frequently signifies a party assembled to play at faro, sharo, or other games of chance, than for the purpose of rational conversation; sometimes an opera, and a masquerade on Sunday, during carnival, in the prince of Biscari's theatre; an *academia*, wherein the *professori* meet the *virtuosi*, not in the old-fashioned way of the Greek philosophers, *quærere verum inter sylvas academi*—no, be it known to the reader, that *academia* is neither more nor less than a concert, the *professori* the performers, and the *virtuosi* the audience.

The ancient Catina produced Carondas the legislator, so much commended by Plato; and Stesichorus the lyric poet, who introduced singing with the accompaniment of the cithara into the chorus.

The Semætus, now the Giaratta, sung by Theocritus, flows through the plains of Catania at some distance from the town. The Naphtha lake, the seat of the oracle of the Palici, hardly second in repute to that of Delphos for its responses, is in the neighbourhood of Catania.

From Catania, Adrian the emperor ascended Etna, "*ut solis ortum videret.*" But this city is so often mentioned by the ancient writers, and the natural phenomena that characterise it are so intimately interwoven with the allegory and fable of ancient mythology, that every stream and fountain in its neighbourhood bear record of its antiquity.[*] (w)

CATAPULTA. See ARTILLERY and *History of* GUNNERY.

CATARACT. See SURGERY.

CATECHU. This is a substance which has been long known under the name of *terra japonica*, being believed to be an earth that came from Japan. It is, however, now known, to be an inspissated vegetable juice, which its name is said to indicate, *cate* signifying a tree, and *chu* juice.

There are two varieties of *catechu*, one comes from Bengal, and the other from Bombay. These differ from each other very slightly in their chemical characters, but may be distinguished by the particular appearance of each. In general, catechu has a pale reddish brown colour, is friable, possesses a lamellar structure and rough fracture; specific gravity about 1.39; taste bitterish and astringent, leaving a disagreeable sweetness; it is infusible, does not deliquesce, and does not exhibit any sensible change in consequence of exposure to the action of the atmosphere. The Bengal catechu may be distinguished from that which comes from Bombay, by being of a darker colour, more nearly resembling chocolate on its exterior surface, and by exhibiting a streaked appearance of chocolate and reddish brown internally. The texture is more uniform, and the fracture more resinous and shining. Its specific gravity is somewhat less, and it is also more friable.

Sir Humphry Davy, at the suggestion of Sir Joseph Banks, analysed both varieties, and the results nearly correspond. We shall give a general statement, which may be considered equally applicable to both, previous to the details of the analyses. Catechu is almost soluble in hot water; the solution is of a deep reddish brown, and reddens the infusion of litmus. By long decoction a solution is formed, which yields, by evaporation, about $\frac{1}{6}$th of its whole weight of solid matter.

The presence of gallic acid and tannin were also distinctly proved, by the black colour produced by sulphate of iron, and by the copious precipitate by animal gelatine.

Catechu contains a peculiar extractive, and a substance resembling mucilage. The last is left pure by the action of alcohol, which dissolves all the other matters. The extractive, when completely freed by washing from the tannin, is slightly astringent, and very sweet when chewed for some time. It is soluble both in water and alcohol, and acquires a deep colour by exposure to the air.

The following are the exact results of the analyses. 200 grains gave,

	Bengal.	Bombay.
Tannin	97	109
Extractive	73	68
Mucilage	16	13
Residual sand and calcareous matter	14	10
	200	200

It has been said to be derived from various trees; but it is certain, that it is most usually obtained from the *Acacia catechu* of Willdenow, which grows abundantly on the mountains of Hindostan, and which is there called *Coira*.[†] It seldom exceeds twelve feet in height, and one foot in diameter. It is covered with a thick coarse bark, and divides into many branches at its top. The leaves are alternate on the young branches, and are composed of from 15 to 30 parts of partial pinnæ, nearly two inches long, each having about forty pairs of linear leaflets beset with short hairs, with a small gland on the leaf stalk between the bases of each pair of the pinnæ. There are two short recurved spines at the base of each leaf.

The flowers are male and hermaphrodite, and spring from the axillæ of the leaves on close spikes four or five inches long. The calyx is tubular, hairy, dividing into five oval pointed segments. The corolla tubular, monopetalous, and twice the length of the calyx. The filaments are numerous, twice the length of the corolla; anthers roundish; germen oval, supporting a slender style of the same length with the stamens, and terminated by a simple stigma.

Fruit lanceolate, compressed, pod smooth, brown, margin thin. It contains six roundish flattened seeds.

The following is the mode of preparation, as narrated by Mr Kerr, who was formerly assistant surgeon to the civil hospital at Bengal.

"After felling the trees," says this gentleman, "the manufacturer carefully cuts off all the exterior white part of the wood. The interior coloured part is cut into chips, with which he fills a narrow-mouthed unglazed pot, pouring water upon them until he sees it among the upper chips: when this is half evaporated by boiling, the decoction, without straining, is poured into a flat earthen pot, and boiled to one-third part: this is set in a place to cool for one day, and afterwards evaporated by the heat of the sun, stirring it several times: when it is reduced to a considerable thickness, it is spread upon a mat or cloth, which has previously been covered with the ashes of cow dung; this mass is divided into square or quadrangular pieces by a string, and completely dried, by turning them in the sun until they are fit for sale.

Catechu is imported into this country in bags, and occasionally in small chests that contain 3 or 4 cwt. each. Both varieties are mixed up together in the same package.

Catechu is used in India in some processes of dyeing. It is a chief ingredient in the betel composition, which is so generally chewed by the natives of the East. The Indians also use it as an ingredient of an ointment, in high repute for curing sores.

In Europe, it is chiefly employed for medicinal purposes. Its astringency renders it peculiarly valuable in some cases of dysentery and diarrhœa, when astringents are indicated. From the quantity of tannin which it contains, it may become a very valuable article in the preparation of leather.

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[*] The Editor has been indebted for this interesting article to a gentleman who resided a long time in Catania.

[†] This tree belongs to the Linnæan class Polygamia, and order Monœcia. Natural order of Linnæus, *Lomentaceæ;* of Jussieu, *Leguminosæ*. See BOTANY for the generic characters.

See *Medical Observations*, vol. v. *Phil. Trans.* for 1803. Aikin's *Chemical Dictionary*. Thomson's *System of Chemistry*. Willdenow, edition of *Linnæus Species Plantarum*. (C. M.)

CATENARIAN CURVE. See BRIDGE, p. 480.

CATERPILLAR. See GARDENING.

CATESBEA, a genus of plants of the class Tetrandria, and order Monogynia. See BOTANY, page 115.

CATHARINE II. Empress of Russia, was born at Stettin May 1, 1729. She was the daughter of Christian Augustus, prince of Anhalt-Zerbst-Dornburg, and of the princess of Holstein; and was originally denominated Sophia Augusta Frederica. Under the judicious and prudent tuition of her mother, who was distinguished for her talents and beauty, she displayed at an early age a taste for learning, and devoted much of her time to literary and philosophical studies. In 1744, she visited, with her mother, the court of Petersburgh, and received from the Empress Elizabeth the most flattering marks of regard and esteem. This princess had been betrothed, and affectionately attached to her uncle the prince of Holstein-Eutin, whose premature death alone had prevented the accomplishment of the marriage; and the appearance of Sophia awakened in her the tender remembrance of her loss. The affection which she cherished for her betrothed husband, she now expressed towards his niece; and scarcely was Sophia settled in the court of Elizabeth, than the plan was formed of uniting her in marriage with the Grand Duke Peter, and of thus raising her to that throne which had been intended for her uncle, but which death had prevented him from ascending.

In the prospect of her exaltation, Sophia formally renounced the doctrines of Lutheranism, in which she had been educated, and embraced the religion of the Greek church, when, at the same time, she assumed the name of Catharine Alexievna. On their first introduction, the young pair were pleased with each other. They were both handsome, and a mutual attachment seemed to be formed, which promised the happiest consequences. But an unexpected circumstance occurred, which not only retarded for a while their union, but which completely alienated the affections of the princess. The Grand Duke was seized with the small-pox, which, being of a very malignant nature, so disfigured his countenance, that Catharine could not behold him without disgust. Ambition, however, was a stronger passion in her heart than love. She had sufficient art to conceal her dislike; and submitted, with apparent cheerfulness, to the nuptial ceremony. Her mother and the empress were both delighted with the alliance. But the abilities and accomplishments of Catharine very ill accorded with the weakness of her husband. She soon began to perceive that her hand had been given to one upon whom she could place neither her affections nor esteem. His follies and vices were to her a daily cause of shame and regret; and she often blushed at beholding him so unworthy of her. Peter, on the other hand, blushed at the superiority of his wife. He felt constrained in her presence. Her company was forsaken; and his days and nights were generally spent in the midst of his dissolute companions. Mutual disgust and jealousy was the consequence, which both parties took so little trouble to conceal, that it soon became apparent to the whole court. But Catharine consoled herself with the hope of a crown; and while the grand duke was indulging in drinking and gaming, she was busily employed in acquiring partisans among the nobles, and in laying the foundation of her future power.

Pleasure, however, was not forgotten, though it never was allowed to interfere with her plans of ambition. She revelled in all the wantonness of an unprincipled and debauched court. Her amours with Soltikof, the prince's chamberlain, were notorious, and her partiality was so unguardedly expressed, that Peter alone was blind to his shame. Such, indeed, was his indifference, that he vindicated before the empress the innocence of Soltikof. Catharine had the address to profit by his folly, and pleaded also the cause of her paramour and of her own honour with such eloquence, that Elizabeth was led to discredit the various reports which were circulated against her, and to receive her again into favour. Emboldened by success, Catharine renewed her correspondence with the chamberlain, which continued without interruption until his removal to Hamburgh as minister plenipotentiary from Russia. His absence, however, and the arrival of the young Count Stanislaus Poniatowsky at the court of Elizabeth, soon produced a revolution in the affections of Catharine. Soltikof was forgotten, and the young Polander had scarcely declared his admiration, than he was admitted into all the familiarities of a favoured lover. This new intrigue was carried on with as little secrecy as the former, and soon spread throughout the court. The enemies of Catharine were loud in their censures. The indignation of the empress was awakened; the jealousy of Peter was alarmed; and the grand duchess was about to be overwhelmed with infamy and disgrace, when she was extricated from her difficulties by the extreme fondness of Elizabeth for the young Paul Petrovitch. When no offer of accommodation would be listened to by the empress, except upon the most mortifying conditions, Catharine asked leave to retire to Germany. This request, she had reason to believe, would not be granted, as her departure would expose her son to the hazard of being afterwards declared illegitimate; and consequently by awakening the feelings of Elizabeth, who was now in her dotage, for her favourite Paul, a conciliation was immediately effected. The storm, which threatened to burst upon her head, was thus dissipated; and to the astonishment of the court, she appeared at the theatre by the side of the empress, who treated her with the most marked and friendly attention.

But the death of Elizabeth and the accession of Peter opened a new field for the genius and exertions of Catharine. She had little to expect from a husband, whom she had so deeply injured, and openly despised; but she had in some measure fortified herself against his power, by her influence with some of the most distinguished nobles of the empire, and had attempted to conciliate the popular favour by an exterior of piety and devotion. The first measures of Peter's reign, however, gave her no uneasiness. He, who when grand duke was dissipated, capricious, and impetuous, was no sooner seated on the throne, than, to all appearance, he was transformed into a temperate, equitable, and enlightened monarch. He retained in their places the great officers of state, and was particularly kind to such as had been attached to Elizabeth. All his former animosities seem to have been forgotten. The grand duchess was treated with marked attention, and received the most flattering testimonies of confidence and esteem. Her opinion was consulted on all affairs of importance. He seemed to delight in her conversation; and to repose himself on the strength of her understanding. Catharine, however, knew too well the temper and disposition of her husband to be deceived by this change in his conduct. He possessed neither judgment nor energy sufficient for the government of a great empire. Inconsistency and levity were the predominant features in his character, and consequently she could have little dependance on his kindness; but was always prepared against the dropping of the mask which he had assumed for ambitious and selfish purposes, and which accorded so ill with the weakness and versatility of his mind.

Peter no sooner supposed himself firmly established upon the throne, and secure of the popular favour, than he resumed his former habits. The greater part of his time was spent in dissipation. His apparent respect for Catharine was turned into indifference, and sometimes to rudeness; and while his mistress, the Countess Woronsof, was publicly distinguished by his attention, she was often subjected to the most humiliating neglect. The countess even boasted of her power over the Czar, and of his intention to raise her to the throne of Russia. He himself took no pains to disguise it; but often hinted his resolution of repudiating Catharine, and of publishing her infidelities; of declaring illegitimate her son Paul Petrovitch; and of adopting as his successor the Prince Ivan, who had been dethroned by Elizabeth. Informed of these designs, Catharine was not idle in adopting measures for their prevention. She had long seen that her only safety was in the dethronement of her husband, and her own exaltation; and had proceeded by slow but certain steps to the accomplishment of her purpose. She had opposed to his harshness and neglect, the utmost address and dissimulation. She affected an air of resignation and piety; accosted the poor with kindness, and attended daily prayers in the churches of Petersburgh. Her situation excited the compassion of the populace, and by her arts she soon gained their affections, which the Czar, by his follies, was rapidly losing. She had also been assiduous in drawing to court, and attaching to her interest, men of courage and intrigue; and did not hesitate in disclosing to a few, upon whose discretion she could depend, her intention of ascending the throne. But her plans were laid with such secrecy and art, that to each of her accomplices, the communication was at first distinct, and each acted without the knowledge or concurrence of another. Catharine herself, in her retirement at Peterhoff, an imperial palace on the gulf of Finland, whither she had been dismissed, animated and directed them all; and impelled by the designs of Peter and the hope of absolute power, she prosecuted her schemes with a wisdom and dispatch, which could not but be attended with the most fortunate result. The chief conspirators were Gregory Orlof, a man distinguished for his courage and strength, but possessing neither the advantages of birth nor education; Lieutenant General Villebois; Hetman Kurilli Razumofsky; Prince Volkonsky; Count Panin; the Archbishop of Novgorod; Lieutenant Passick; and the Princess Dashkof; all determined and active characters. But Catharine was also aided in her purpose by the indolence and indiscretion of the Czar, who, confident of security, was wasting his days in the midst of his profligate and artful companions; and by delaying the execution of his own designs against the empress, hastened his destruction. Even when he was informed that a conspiracy was on foot, he disregarded the intelligence, and could not be prevailed upon to seize those who were suspected.

When the plot was sufficiently matured, and the conspirators had resolved upon the dethronement of the Czar, they chose the anniversary of St Peter and St Paul, as the most proper opportunity of seizing his person. This anniversary was to be celebrated at Peterhoff, and the conspirators awaited only the arrival of the Czar to complete their purpose. But before the appointed time the plot was discovered, and Passick, one of the principal actors, was immediately arrested. The conspirators were struck with consternation. Peter was for the present secure from their power, and the first step of their design was frustrated. But all was not lost. They were only driven to hasten their measures, and they determined, that very night, before the Czar could be informed of their proceedings, or take any steps for preventing them, to carry Catharine to Petersburgh, and proclaim her sovereign of all the Russias.

Catharine, under pretence of leaving the apartments of the palace free for the approaching festival, but in reality with a view of facilitating her escape to Sweden should her plot fail, had retired to a remote summerhouse, called Montplaisir, situated at the extremity of the garden on the shore of the gulf. Here she had concerted with her associates the measures which were to be pursued, and remained in quiet expectation of the result. But about two o'clock in the morning, she was aroused from a profound sleep by the unexpected entrance of a soldier, who delivered a note from the Princess Dashkof, and said, "your majesty has not a moment to lose, get ready to follow me." Catharine was at first thunderstruck, but immediately recollecting herself, and summoning all her resolution, she disguised her dress so as to elude the observation of the sentinels about the palace, and with her attendant Ivanovna hastened to the carriage, which Alexius Orlof, one of the conspirators, had ready at the garden gate. They set off at full speed, and after some interruption, arrived safe at Petersburgh by seven in the morning. A small band of soldiers hailed her arrival with joyful acclamation; and swore to die in her defence. Others soon followed their example, and in a few hours the whole city was in motion. The troops declared their allegiance on a crucifix; and in the midst of a vast concourse of spectators, Catharine was crowned, in the church of Kasan, by the Archbishop of Novgorod, who proclaimed her sovereign of all the Russias, and declared Paul Petrovitch her successor in the empire. The *Te Deum* which followed was accompanied by the shouts of the multitude; and when Catharine returned to the palace, crowds of the inhabitants flocked thither to take the oath of fidelity, among whom were many of the principal nobility, who cheerfully joined their homage to that of the multitude.

Thus was a most important revolution effected without bloodshed; and before the evening, Catharine saw herself in possession of a well fortified capital, a devoted populace, and 15,000 chosen troops. But of the consequences of this revolution; the dethronement and murder of Peter III.; the assassination of the unfortunate Ivan; and those wise and vigorous measures, by which she supported her usurpation, extended the boundaries of her empire, and raised it to its highest glory, we must refer for a particular account to the article RUSSIA. Instead, therefore, of anticipating here what will be more properly introduced under that head, we shall only observe, that her policy, in almost every instance, was dictated by a spirit of ambition and vanity, which often led her to promote or to sacrifice the happiness and interest of her subjects, according as it suited her own views of aggrandisement. The object of all her public conduct was the advancement of her own fame. To this end her attention and exertions were continually directed. She affected to imitate and rival the most illustrious deeds of former monarchs, and was incessantly engaged in measures that might attract the reverence and admiration of the world. She laboured, like Frederick of Prussia, to render her capital the seat of literature and the sciences; she encouraged commerce and manufactures; reformed abuses in the state; and cherished, to the end of her life, the favourite and mighty project of expelling the Turks from Europe, and of reigning in the ancient capital of the eastern empire.

But notwithstanding all her exertions for promoting the welfare of her people, the system of favouritism, by which her government was administered, often proved most destructive to their happiness. This system had been followed by the former empress, and was strengthened by the nature of Catharine's situation. She had usurped a throne, and her accomplices aspired to become her equals. From these some of her principal favourites were chosen; but others were merely fortunate adventurers, chiefly distinguished for their beauty and accomplishments. Of the former, the chief was Gregory Orlof, a man of rough expression and brutal manners; and among the latter, was Potemkin, whose splendid talents, elegant manners, and military exploits, are still remembered in Russia with enthusiasm. Whoever enjoyed the protection of the reigning favourite, could exercise the most undisguised tyranny and injustice. Every dependent was a petty despot, who could trample upon his inferiors, and violate the laws with impunity; and thus her administration, which, within the immediate circle of her own influence, was mild and temperate, was at a distance arbitrary and oppressive.

Catharine, from the commencement of her reign, was almost constantly engaged with schemes of foreign aggrandisement; and during a long and prosperous life, she annexed to her dominions, by her arms or by intrigue, the Crimea, the Kuban, and part of the frontiers of Turkey; Courland, and Semigallia; and nearly one half of Poland, besides immense tracts of country in northern Asia. She had also penetrated into Persia, and taken Derbent; and by her treaty with Great Britain and Austria in 1795, called the "triple alliance," she looked with confidence to the conquest of Constantinople. But she was stopt in her ambitious career by a fit of apoplexy, which carried her off on the 10th of November 1796. On the morning of the preceding day she was in good spirits, and having taken her coffee, had retired to her closet: but remaining longer than usual, her attendants were alarmed, and upon entering her apartment, found her lying speechless on the floor! Dr Rogerson, her physician, being immediately called, ordered her to be bled, which gave her some relief, but she lingered only until the following evening, when she expired in the 66th year of her age, and the 35th of her reign. Her remains were laid in state by the side of those of her unfortunate husband, and a true love knot, which reached from one coffin to the other, bore this inscription in Russ characters, "Divided in life—united in death." These were then deposited in the same tomb, in the church of St Alexander Nefsky.

Catharine was of a middle stature, rather inclined to corpulency, and well proportioned; but her erect walk and dignity of demeanour gave her a tall appearance. She had an aquiline nose, a chin somewhat long, an agreeable mouth, auburn hair, and blue eyes, arched with black and thick eye brows. "Her physiognomy," says one of her biographers, "was not deficient in expression; but that expression never discovered what was passing in the soul of Catharine, or rather it served her better to disguise it." Dissimulation, indeed, was the occupation of her life. She had been early practised in its arts, and she gained the favour of her people more by her hypocritical devotion, than by any other action of her reign. Though an infidel in principle, and a disciple of the new philosophy; though she often expressed her contempt for the doctrines and ceremonies of the national religion, and even held its ministers in abhorrence, yet she sometimes condescended to enter into its most childish superstitions. She not only attended the churches during public worship, and prayed with all the semblance of a sincere and fervent piety, but she was punctual in the most superstitious practices of the Greek religion. On her journey to Moscow in 1775, she carried with her a great number of little figures of saints, which she distributed in churches and chapels on the road; and even performed a pilgrimage with all her court, to a convent situated about 40 versts from that city, walking on foot the whole way. The garb of religion was assumed by her merely for purposes of policy, in order to gain the affections, or to attract the reverence of the ignorant multitude. In private, she was destitute both of its influence and its spirit. In the midst of a licentious court, she herself was the most licentious. After the death of Peter III., she would never submit to the authority of a husband, though repeatedly solicited both by Orlof and Potemkin; but chose rather to indulge herself in all the variety of unrestrained wantonness. Whenever she cast her eyes upon one of her subjects, whom she wished to exalt to the situation of favourite, she immediately created him her general aid-de-camp, that he might accompany her every where without reproach or observation; and appointed him an apartment in the palace, which apartment communicated with that of the empress by a private passage. He was then given to understand, that, if he wished to retain her favour, he must not converse familiarly with any other woman, or leave the palace without express permission. When the favourite had rendered himself obnoxious, or had lost the power of pleasing, he received orders to travel; but his dismissal was accompanied with a suitable recompense, which, in general, corresponded with the time he had served her majesty. During her reign, twelve persons had been distinguished by this high honour, upon whom she bestowed in lands, money, jewels, &c. to the value of above 88,000,000 of rubles; and the estates which were given to the family of Orlof alone contained nearly 45,000 boors.

The love of fame was another predominating feature in the character of Catharine. Whatever was likely to conduce to the advancement of her glory, was undertaken with eagerness, and prosecuted with vigour. This passion, which in her degenerated into vanity, often led her to engage in unjust wars, from which no benefit was to be reaped either to the empire or herself, but the empty satisfaction of having conquered. It however also induced her to undertake many projects, both laudable in themselves and beneficial to her subjects; but such was the restlessness of her mind, that her plans seldom received their full execution. She was continually carried away by some new passion, to which all preceding ones gave place; and this continued only until some other idea of stronger influence was started. Every thing was begun with great pomp, but was soon forgotten, so that at her death, the monuments of her reign are said to have resembled so many wrecks and dilapidations: colleges, colonies, education, establishments, manufactories, hospitals, canals, towns, fortresses, &c. all had been begun, but all were given up before they were finished. This weakness of Catharine's drew a most satirical remark from the emperor Joseph II. When travelling in the Crimea, he was invited by the empress to place the second stone of the town of Ekatarinoslaf, of which she herself, with great parade, had laid the first; and on his return he said, "I have finished in a single day a very important business with the empress of Russia, she has laid the first stone of a city, and I have laid the last." Her vanity led her even to aspire to literary fame, and to rival the reputation which Frederick of Prussia had obtained by his writings. She wrote her celebrated "Instructions for a Code of Laws," copies of which were sent to several of the sovereigns of Europe for their approbation; some dramatic pieces, which were acted and admired at the Hermitage; and several moral tales and allegories for the instruction of her children. But these were praised rather on account of the hand that wrote them, than for their merit; and the best of all her writings are her Letters to Voltaire, which are indeed much more interesting than those of the old philosophical courtier himself.

With all her failings, however, Catharine possessed many noble qualities, which shed a lustre over her reign, and which will be long remembered by her country. The murder of her husband, and the butcheries of Ismail and Warsaw, were the crimes of her station, not of her heart. The one, as she had usurped a throne, was necessary for her own safety and the continuance of her power; the others arose from the bloody dispositions of the Russian soldiery. Catharine was naturally humane and generous, of most engaging manners, and was never known to be immoderately transported with passion. Her criminal laws breathe a spirit of mildness, worthy the imitation of more civilized nations; and during her long reign a sentence of death was extremely rare. Though possessed of absolute power, yet, in her "Instructions," she acknowledges no authority but that which was founded upon justice; and her whole plan was directed to the formation of a solid legislature, and to prevent the capricious injustice of all who were intrusted with the administration of the laws. Her spirit of toleration was truly admirable. At the commencement of her reign, she laid down a resolution, which she adhered to, without any deviation, to the last day of her life, that no person should suffer in any respect on account of his religious opinions. Papist, Calvinist, Mahometan, or Heathen, could aspire to any office in the state, civil or military, without any apprehension of his being rejected for his particular creed. When once speaking of heretics, she said smiling, "Poor wretches, since we know that they are to suffer so much, and so long in the world to come, it is but reasonable that we should endeavour by all means, to make their situation here as comfortable to them as we can."

As a sovereign, Catharine ranked among the wisest and most powerful princes of her age; and it is a sufficient evidence of her fortitude, abilities, and decision, that, though a foreigner and usurper, she maintained her authority in the midst of disaffection and rebellion, extended the boundaries of her empire, and made her vices be forgotten in her greatness, and her apparent regard for the public good. "Her sex," says one of her biographers, "giving a bolder relief to the great qualities displayed by her upon the throne, will place her above all comparison in history; and we must recur to the fabulous ages of an Isis or a Semiramis, to find a woman who has executed, or rather undertaken such daring projects." Among these projects, however, her usurpation of Courland, and the partition of Poland, will ever stand against her as monuments of her rapacious injustice, though they have been equalled in later times, and may be attempted to be justified by the general practice of nations, who, in their rage for conquest, are seldom guided by the principles of justice and good faith. See Segur, *Vie de Catharine II. Imperatrice de Russie;* Tooke's *Life of Catharine II.;* Coxe's *Travels*, vols. i. and iii.; and Rulhiere, *Histoire ou Anecdotes sur la Revolution de Russie.* (*p*)

CATHARINE'S, St, an island on the coast of Brazil, situated in Long. 47° 37′ west, and between 27° 19′ 10″ and 27° 49′ of south latitude. It is about six miles broad in its narrowest part, and is separated from the continent by a channel about 400 yards wide. The surface of this island is diversified with mountains, plains, and swamps. The mountains of the interior, and the conical rocks which rise abruptly from the sea, are of primitive granite. Close to the fort, on the left hand of the entrance to the harbour, is a vein of grunstein in different states of decomposition, which ultimately changes into clay of a quality superior to that which is found in the valleys. The island is covered with trees that are perpetually green, but from their being intermixed with briars and thorns, the forests are impassable, and are said to be infested with noxious serpents. The houses are erected on the margin of the sea; and the surrounding woods, abounding in orange trees and aromatic plants, yield a most delightful fragrance.

The soil in the interior of the island, though rather humid, is surprisingly fertile; it consists chiefly of a rich vegetable decomposition, and yields almost spontaneously all sorts of fruits, vegetables, and grain. The cultivated lands are under considerable improvement. They were formerly covered with large trees; but as great quantities have of late years been cut down for the purposes of ship-building, good timber is now scarce. Flax, from which the fishermen make their lines, nets, and cordage, grows here of a good quality. The produce of St Catharine's consists in rice, maize, mandioca, coffee, oranges, lemons, citrons, cotton, sassafras, and guiacum. Sugar and indigo are raised in small quantities, and the potatoes are reckoned the finest in the world.

The climate is healthful and serene. The prevalent winds, which are from the south-west and north-east, moderate the solstitial heats. The former prevail from September to March, and the latter from April to August. The genial nature of the climate is indicated by a profusion of the finest flowers. The rose and the jessamine are in bloom all the year round. Myrtles are very common, and a beautiful variety of the passion flower is found in equal abundance. The principal animals are opossums, monkeys, and armadillos. The beautiful coral snake occurs among the numerous tribe of serpents; and the principal birds are, cranes, hawks, parrots, humming birds, and toucans. The sea produces a variety of excellent fish, and so well is the market supplied, that a quantity sufficient to dine 12 persons may be had for a shilling. A large ox cost 8 piastres, (when La Perouse visited the island,) a hog of 150 lb. cost 4 piastres, and turkies were sold for a piastre the pair. In 1804 the price of meat was about 1½d. per pound, and poultry, eggs, and the finest vegetables, were both abundant and cheap.

As the inhabitants require all the produce of the island for their own consumption, their trade is of course inconsiderable. Numerous coasting vessels from Bahia, Pernambuco, &c. bound for the La Plata, touch here; and the island is amply supplied with artisans of all descriptions.

From the landing place, which is at the bottom of a verdant slope of about 500 yards, the town has a very beautiful appearance, and its fine cathedral appears in the distance. The town consists of several streets. The houses, which have two or three stories with boarded floors, are well built, and they are provided with neat gardens. The number of inhabitants is between five and six thousand. On entering the port of St Catharine's by the north, there are several islands. On one of them, to the westward of the entrance, is the fort of Santa Cruz, the most considerable in the island. Off this fort, there is a safe anchorage for a fleet of ships of war, and ships of 300 tons may enter the harbour. There are several watering places on the island. The fort of Santa Cruz is only a large enclosed battery, and is incapable of making a regular defence. The garrison in 1785 consisted of 50 men, ill paid and clothed. Here are other four forts, Porto Groed, Ratones, Estreito, and Concepção.

The island of St Catharine's is divided into 4 parishes, 1st, Nossa Senhora de Dereito; 2d, St Antonio; 3d, Laguno; and 4th, Riberon. The divisions on the opposite part of the coast, called, 1st, St José; 2d, St Miguel; Nossa Senhora de Rosario, are under the jurisdiction of the governor of St Catharine's, who, in some instances, is subject to the government of Rio de Janeiro, and, in others, to the captaincy of St Paul's. The inhabitants are in general hospitable and obliging to strangers. The ladies are handsome and lively, and are chiefly employed in the manufacture of lace.

The population of the island, and of its dependencies on the opposite coast, amounts to about 30,000. See La Perouse's *Voyage*, vols. i. and ii.; but especially Mawe's *Travels in the Interior of Brazil, particularly in the Gold and Diamond Districts of that Country*, by authority of the Prince Regent of Portugal. London, 1812. (π)

CATHARTOCARPUS, a genus of plants of the class Decandria, and order Monogynia. See BOTANY, page 215.

CATHEDRAL. See CIVIL ARCHITECTURE.

CATHETER. See SURGERY.

CATHMANDU. See KHATMANDU.

CATHOLICS, ROMAN. See ECCLESIASTICAL HISTORY, and BRITAIN *Index*.

CATILINA, L. SERGIUS, a patrician of Rome, was descended of an old and respectable family. Neither his father nor grandfather appear to have filled any public office, but several of his ancestors were men of talents and of consideration in the state. See *Pliny*, vii. 2[illegible]. His great grandfather was prætor of the city in the year U. C. 553, and obtained great credit for his moderation and integrity. See *Livy*, l. xxxii. c. 27, 29, 31, and lib. iii. c. 21, 24. When Catiline first entered upon the stage of public life, the highest expectations were formed of his future eminence, and though his character was not free from all imputation of levity, yet his fellow citizens reposed with confidence on his patriotism, and excused his excesses as the errors of unguarded youth. But in the discharge of the office of prætor, to which he was elected at the usual age, he shewed such complete want of principle, and such unbridled profligacy, that it was easy to foresee, in the conduct of the abandoned magistrate, the depravity of the future traitor. In the year after, he was sent as the pro-prætor to Africa. In this situation he governed with the utmost inhumanity, and, to feed his extravagance and debauchery, exacted immense contributions from the inhabitants. The oppression of his administration was so severely felt, that a deputation was sent from Africa to impeach him of cruelty and extortion.[*] But it seldom happened that the unhappy provinces, which suffered all the miseries of war, aggravated by the permanent and arbitrary despotism of capricious governors, could obtain redress by an appeal to Rome: (*Cicero in Verr.* passim.) The senate, conscious of their own injustice and rapacity, felt the inconsistency of punishing in others the crimes which they had themselves committed, and often made common cause with their officers against the wretched provinces. Catiline was acquitted, and no notice, in consequence of these proceedings, was taken of him, but to declare him incapable of standing candidate that year for the consulship, because he had neglected to register his name. During this prosecution, Catiline requested Cicero to be his counsel, who either was, or pretended to be, so much deceived regarding his real character, that he at first consented, but, in consequence of the disclosure of some acts of villainy, afterwards refused.[†]

The excesses and prodigality of Catiline after his return from Africa involved him in much embarrassment; and it was from the pressure of pecuniary distress, and the galling load of public infamy, that he first formed the design of enriching himself in the spoils and destruction of his country. Bold as such a scheme was, and appalling one would have thought to every mind, however depraved and hardened, there were not wanting numbers in Rome, who, from their profligacy and despair, shrunk from no enterprises or enormities which could promise them any relief. "*Qui ob summam miseriam nullam deteriorem conditionem pertimescentes, dum turbare ac miscere omnia, in meliorum fortunas et opes impellebant veluti ad hostium prædam.*"[‡] While he secured a sufficient number of these needy villains, whom gold could easily tempt, "unto a close exploit of death," Catiline was not inattentive to the arts by which he could gain adherents of more influence and importance. With this view, he drew around him many young men of family, by his attractive and fascinating manners, whom he led gradually on to vice, until he had ruined for ever their characters and their fortunes, and made them companions in profligacy. When, like the envenomed spider, he had entangled his victims irretrievably in his snares, and plunged them into the gulf of ruin, he proposed to them his plan of extricating themselves by the overthrow of their country, or the dreadful alternative of dying in the haunts of misery and vice, and exposed to the execration of every good and virtuous Roman. Their hesitation was not long; and thus were the materials of a mine laid, which had nearly exploded in the centre of Rome, and covered the world with its fragments. In the mean time Catiline stood candidate for the consulship, backed with the powerful support of Crassus and Cæsar. Among his competitors was M. Tullius Cicero, whose integrity and transcendant talents rendered him equally an object of hatred to every faction, and of admiration and confidence to the good and the wise. Some suspicions of Catiline's designs having been surmised among the people, they took alarm, and chose Cicero and Antonius consuls. The fury of Catiline, on being thus baffled in his attempt to retrieve his ruined fortune, broke out into the most violent turbulence, and happily discovered to the Romans the character of this candidate for power and popularity. The consuls and patricians were on their guard at the next election, and effectual measures were taken to prevent his success. Irritated by the vigour and opposition of Cicero, whose powerful mind disconcerted all his designs, and met him in every plot, he resolved to assassinate him and the other consul, on the day of election for the ensuing year. But the genius of Cicero still predominated; the plot was discovered, and Catiline rejected with disgrace. His outrageous resentment precipitated him into open rebellion, and several armies of his partizans were collected in different parts of Italy. The event of this rash conspiracy, and the circumstances connected with it, are so well known, and have been blazoned forth with such parade in every page of Cicero's writings, that any detail of them here is wholly unnecessary. It is customary to represent Catiline as a mere tool employed by Cæsar and Crassus to corrupt the people, and alienate them from their attachment to the established constitution, but whose impetuosity and ambition carried him to lengths to which these more wary politicians were unwilling, openly at least, to proceed. But in this opinion we cannot concur. The conduct and views of Catiline betrayed none of the artifices or subserviency of an instrument of faction. He had no design of advancing the interests of any party or political leader. His object was not to depress one party in order to raise another, but the destruction of all parties, and the general ruin and desolation of the state.

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[*] *Multæ graves sententiæ* (inquit Pedianus in Cic. Orat. in Tog. Candid.) *in eo dictæ sunt.*

[†] Fenestella says, that Cicero did defend him; but this is a mistake, as Torquatus was his counsel. See *Cicero Orat.* pro Sylla.

[‡] See the elegant work of Gravina *De Ortu et Progressu Juris Civilis*, lib. i. sect. 12, for a most nervous and eloquent description of the blood-thirsty ferocious savageness of these hardened monsters.

Of the character of Cataline in early life, and of the habits which drew him on to such a consummation of wickedness, it is much to be regretted that no full account has been transmitted to us. It would have been a most instructive moral lesson to mark the progress of such a man, and to witness the delusions and wickedness which insensibly brought him into the rapid whirlpool of vice. Sallust mentions, in general terms, that he was a profligate almost when a boy, and was early hardened in guilt. But the authority of Cicero, who says, that originally he had a good disposition, and evinced a strong desire of honourable distinction, is on this point unimpeachable. "*Habuit ille permulta non expressa signa sed adumbrata virtutum*," &c. But of the power and vigour of his talents, of his ardent and comprehensive mind, and of the dauntless and lofty intrepidity of his character, he has left too striking proofs to allow any slur to be thrown upon his abilities. Bold and fertile in invention, and of invincible perseverance and courage in execution, he was well fitted for the head of a faction. Yet the same qualities, kept under steady controul by reason and prudence, would have rendered him an ornament to his country. But he was naturally volatile; and his keenness of disposition led him to join with equal eagerness in the society of the virtuous or the profligate, in the pursuits of virtue, or the indulgence of vice. Unaccustomed to regular restraint, his mind yielded easily to temptations; and by a lamentable perversion of talents, he became the first in the career of licentiousness, as he had once been also in more becoming and worthy occupations. It was natural that a character produced by so strange a mixture of vicious and praiseworthy principles, by a combination of passion with the talents and energy that could render it formidable, should prove dangerous to the liberty and independence of his country. But the actions of Catiline, let it be remembered, are preserved to us only in the treacherous and exaggerated statements of political adversaries; and we ought to receive with caution the invectives with which his memory has been loaded. At the period when his conspiracy was formed, the internal condition of Rome was such as to make almost any change preferable to her lifeless and degraded government. The people were corrupt and licentious; more interested in the triumph of the factions to which they had attached themselves, than in securing the freedom, and promoting the welfare of their country. The energy and spirit of public virtue was palsied by the deadening influence of luxury; and the public opinion, the firmest bulwark against the encroachments of tyranny, was now employed to buoy up the vices of party. The government was become a capricious oligarchy; a few ambitious and intriguing leaders, to whose power and influence the liberty of the people was sacrificed, divided the state, and embroiled it in the miseries of civil dissensions. To the arrogance and struggles of these conflicting factions, the people submitted with abject acquiescence; they even encouraged and strengthened the intrigues of party; and though a determined resistance might have crushed this many-headed monster, they seemed to consider that their hopes of liberty were gone, and thoughtlessly joined in raising the power which finally reduced them to subjection. While such was the situation of Rome, we cannot wonder that a man of ardent and enterprising talents should have seized the opportunity which her distracted state afforded of aiming at absolute power. (J. H.)

CATO OF UTICA, a celebrated Roman, was the great-grandson of Cato the Censor. At a very early period he was left an orphan, and, along with his brother Cassio, and his sisters Porcia and Servilia, was brought up in the house of Livius Drusus, his maternal uncle, who at that time had great influence in the administration of public affairs. He soon gave marked indications of that firm, virtuous, and decided character, by which he was afterwards so much distinguished. It appeared in his look, in his manner, in his conversation, and even in his amusements. Plutarch relates various anecdotes of his childhood, which shew how much the dispositions of the boy resembled those of the man. One of these particularly deserves to be mentioned. When in his fourteenth year, he happened to be in Sylla's house, and seeing the heads of many illustrious persons carried out, and the spectators sighing in secret at the bloody scene, he asked his preceptor, "Why somebody did not kill that man?" "Because," said he, "they fear him more than they hate him." "Why then," said Cato, "do you not give me a sword, that I may kill him, and deliver my country from slavery?" His austere manner of life led Cato to be partial to the doctrine of the Stoics, whose philosophy he studied and embraced. He also devoted considerable attention to popular eloquence, in which he became no mean proficient. In the servile war with Spartacus, he served as a volunteer, and gave such proofs of his military skill and courage, as to secure for himself the highest praises of the commander, and afterwards a tribune's commission in the army sent into Macedonia under the Prætor Rubrius. On being appointed to the office of quæstor, for the duties of which he had prepared himself with great industry, he introduced a very thorough reform into that department, correcting with an unsparing hand the abuses which had crept into it, punishing those who had been guilty of introducing them, and putting the affairs of the treasury on a new and excellent footing. For his conduct in this, he received great applause from the people. The office of tribune which he filled in the consulship of Cicero, was equally honoured by his integrity and public spirit. He obtained it in spite of very formidable opposition, by the assistance of men of honour and virtue, and he discharged its functions, in the midst of many difficulties, with credit to himself, satisfaction to the people, and advantage to the state.

Cato took an early and conspicuous part in the public transactions of that most interesting and momentous period in the history of Rome. His whole conduct seems to have been actuated by a spirit of patriotism. He respected men in proportion to their solicitude for the general welfare. To those who were hostile or indifferent to the interests of the republic, he set himself in active and undaunted opposition; and forgot personal comfort, and the partialities of friendship, and every private consideration, when the interests of his country demanded his aid. To Cicero he gave his warm support; not yielding to him implicitly in every case, but defending the great principles and features of his administration, and openly bestowing upon him the title of Father of his Country, an eulogium of no mean value as pronounced by the stern and patriotic Cato. He shewed great zeal and courage in attacking those who had joined in the conspiracy, of which Catiline was the head, and succeeded, by his energy and his eloquence in the senate, in procuring the capital punishment of the conspirators. On this occasion he boldly attacked Cæsar, who argued for mild measures, and who himself was not altogether free from suspicion of being a partaker in the guilt of those for whom he pleaded. Fearing every thing that was bad to the commonwealth from the vast and unprincipled ambition of this extraordinary man, Cato regarded him with jealousy and distrust, and thwarted him without ceremony and without intermission, in those projects by which he attempted to aggrandize himself at the expense of his country. After a variety of occurrences, in all of which Cato acted in the most disinterested manner, as well as with his characteristic boldness, the fate of Rome came to depend upon the issue of a contest between Pompey and Cæsar. Although he had disliked and opposed many of the proceedings of Pompey; although he had on some occasions met with very injurious treatment from him; and although the prospect of that civil war, which was now inevitable, filled him with sorrow; yet, sensible that it was necessary to take a decided part, and that the only hope which remained for the liberties of Rome, was to be derived from Pompey's success, he attached himself to the cause of that general, and co-operated with him for the discomfiture and humiliation of Cæsar. The prudence of some parts of Cato's conduct in this important crisis, may perhaps be disputed; and it has even been suspected that his hostility to Cæsar was partly produced by the personal injuries which he had received. But when it is recollected that the injuries alluded to were the effects of the profligacy of Cæsar, who had debauched Cato's sister; and that the difficulties which a man of real virtue had to struggle with in those corrupted times were neither few nor inconsiderable, the character of this patriot cannot suffer from such partial and feeble imputations. After the fatal battle of Pharsalia, Cato retired into Africa with the forces under his command, expecting to meet with Pompey. Hearing of Pompey's death, he marched into Lybia to join Scipio, which he accomplished after a painful and hazardous march in the midst of winter. Scipio acted rashly and foolishly: for though Cato, who remained in Utica as governor of the town, strongly advised him not to risk a general engagement, he despised the advice, and was completely overthrown. Cæsar advanced to Utica. "Strange!" said Cato, when he heard of his approach, "it seems he takes us for men!" Cato was determined not to fall into the conqueror's hands: and seeing no chance of escape, or of successful resistance if he should escape, he resolved to fly to the last refuge of a Roman. Having demanded a sword, and read Plato's dialogue on the immortality of the soul, he stabbed himself under the left breast. The physician attempted to sew up the wound, but Cato tore it open again, plucked out his bowels, and instantly expired. Cæsar, on receiving the intelligence of Cato's death, is reported to have exclaimed, "Cato, I envy thee thy death, since thou couldest envy me the glory of saving thy life." Cato was forty-eight years of age when he died. He left a son and daughter. The former was worthless: the latter married Brutus who killed Cæsar, was trusted with the secret of the conspiracy, and died as her father had done. See *Plutarch*, *Sallust*, &c. (τ)

CATOPTRICS, from *κατοπτρον*, *speculum*, and that from *κατα* and *οπτομαι*, *I see*, is that branch of optics which treats of the laws and properties of light, when reflected either from plane or curved surfaces. See the article OPTICS. (w)

CATTLE. See AGRICULTURE, *Index*.

CATULLUS, CAIUS VALERIUS, a celebrated Roman poet, was born at Verona, of a respectable family, probably about the year of Rome 667. His father, Valerius, appears to have been a man of some consideration in the commonwealth; at least, it is certain that he enjoyed the friendship of Julius Cæsar, who was in the habit of lodging at his house, when he happened to pass by the way of Verona. Although by no means in very opulent circumstances, Catullus must have inherited a moderate fortune; for he not only possessed a small villa at Tibur, whither he occasionally retired from the bustle of a city life; but in the beautiful little poem, which he addressed to the peninsula of Sirmio, he speaks of that delightful spot as his hereditary property, and his home.

He accompanied Memmius, the prætor, in his expedition to Bithynia; from which, however, he tells us, neither he nor his comrades derived much emolument or advantage:

> Id quod erat, mihi nec ipsi,
> Nec prætoribus esse, nec cohorti,
> Cur quisquam caput unctius referret.—X. 9, &c.

In his progress to Bithynia, upon reaching Troas, he had the misfortune to lose his brother, whom, in several of his poems, he laments with great feeling and tenderness.

Catullus usually resided at Rome, where he devoted his time to literature, to society, and pleasure. His wit and genius recommended him to the company, and procured him the friendship of many of the most distinguished characters of his age and country, among whom were Manlius Torquatus, Cicero, Calvus, an orator and poet, Cornelius Nepos, to whom he dedicated his poems, Asinius Pollio, Lucretius the poet, and several other persons of no mean reputation. His mistress, whose real name was Clodia, was celebrated by him under the name of Lesbia, probably from Lesbos, the birth-place of Sappho. This lady, to whom he appears to have been much attached, became, as he himself informs us in one of his poems, not in the most delicate terms, a common prostitute.

Catullus was a man of learning, according to the notions of his age, having acquired a perfect knowledge of the Greek language, from which he translated two of his most beautiful poems,—the one from Sappho, and the other from Callimachus. Hence, he came to be distinguished by contemporary writers by the epithet *doctus*. The precise date of his death is uncertain; but that event is generally believed to have taken place about the fortieth year of his age.

A considerable proportion of the poems of Catullus consists of verses written upon amatory subjects, of which some are exquisitely beautiful, while many are rendered disgusting to every reader of chaste feelings, by the most offensive indelicacy. The grossness which pervades these productions has been ascribed, in a great measure, to the influence of the depraved taste of the times, in which compositions of this nature were not merely tolerated, but highly relished; and Catullus himself endeavours to extenuate his offences against decency, by observing, that the morals of a poet ought to be irreproachable, but that his verses need not be pure.

> Nam castum esse decet pium poetam
> Ipsum, versiculos nihil necesse est.—XVI. 5.

Such a distinction, which is but too often attempted to be drawn by amatory poets, we conceive to be altogether inadmissible. What a good man writes ought to flow from the same principle with what he does; and if any one countenances, or disseminates vice or indecency by his writings, it is something worse than absurd to attempt to justify himself by an appeal to the purity of his conduct. Nor can we allow the gross taste of the times in which he lives to constitute a legitimate apology for the obscenity of an individual writer. It ought to be the study of every virtuous man, to preserve himself free from the contagion of licentious example; and this is a duty, if possible, still more incumbent upon an author, who labours not only for the age in which he lives, but for posterity; and whose writings, therefore, may have no trivial influence on the opinions and moral conduct of remote generations. Besides, we know that other authors, nearly of the same age with Catullus, preserved, in general, throughout their works, a purity of principle and decency of expression, which entitle them to the praise of virtue, as well as of genius.

Catullus also wrote bitter satirical invectives against those whose conduct incurred his disapprobation. In some of his pieces of this description, he severely attacked the character of Julius Cæsar, under the name of Romulus. This extraordinary person, whose private life laid him sufficiently open to censure, could not fail to be incensed at seeing himself thus exposed to public view in an unfavourable light; but the poet having afterwards made an apology, Cæsar generously forgave him, and lived with him on the same friendly footing as he had previously done. Most of these epigrammatic effusions are composed in iambic and Phalæcian verse of eleven syllables, called *versus hendecasyllabi*; and are remarkable chiefly for their poignant severity and licentious indelicacy.

The poems of Catullus were highly esteemed by the ancients, several of whom speak of the author and his works in terms of respect and admiration. Indeed, if we select from among the number of his productions, such as are free from indelicate allusions and obscene language, we shall find much that deserves to be admired. He has a sweetness and classical propriety of expression, a tenderness and playful simplicity, which must render his verses interesting to every reader of taste and feeling.

The principal editions of the poems of Catullus, according to Bayle, are those of Scaliger and of Passerat. The oldest edition is probably that of Venice, 1488, with the comments of Anthony Parthenius. There are also the edition of Grævius, Utrecht, 1680, in 8vo. with the entire notes of a great number of commentators; that of Isaac Vossius, Lond. 1684, in 4to, with a very learned commentary; the *Variorum* edition of Frankfort, 1621, by John Gebhard, with the very ample index of Tuscanilla; the edition of Vulpius, 1710, 4to.; of Mattaire, 1715, 12mo. and in the *Corpus Poetarum*; of Silvius, *in usum Delphini*, Paris, 1685, 2 vols. 4to.; the Cambridge edition, 1702, 4to.; and Baskerville's, Birmingham, 1772, 4to. An English translation in verse, with the Latin text and notes, was published in 1795.—Fabric. *Bib. Lat.* tit. i. c. 5. p. 60, &c.; Bayle's *Hist. and Crit. Dict.*; and Adam's *Classic. Biog.* (*z*)

CATURUS, a genus of plants of the class Diœcia, and order Triandria. See BOTANY, p. 328.

CAVAN, an inland county in the province of Ulster, Ireland, situated midway between the Atlantic Ocean and the Irish Sea, from the shores of which its eastern and western extremities are each distant about 14 miles. It is bounded by the county of Fermanagh on the north; by Monaghan on the north-east and east; by Meath, West Meath, and Longford on the south; and by Leitrim on the west. Its greatest length, from east to west, is about 51 English miles; and its greatest breadth, from north to south, 28 miles. Its area contains 758 square miles. The whole county is covered with hills, of which none rise to any remarkable height, though Sliebh-Russel, and the mountains of Ballynageeragh, strongly mark its northern and western boundaries; and Bruce Hill is a striking object in its southern extremity. The waters which issue from the lakes in West Meath flow through this county; and, expanding in some places into small lakes, retaining in others the appearance of rivers, form many picturesque and beautiful scenes. Cavan can scarcely be regarded, however, as a desirable place of residence. Its climate, though salubrious, is boisterous, cold, and uncomfortable; except on a few gentlemen's seats, it is sheltered by no forests or plantations; and though its interior is adorned by lakes of great extent and beauty, in many places, particularly to the north and west, it is bleak, dreary, and exposed. The soil is in general poor, and though almost the whole of it is under tillage, yet the wretched system of agriculture which prevails here contributes but little to its improvement. It is chiefly occupied by manufacturers, who rent small farms, seldom exceeding 20 acres; and whose principal object is to raise a sufficient quantity of oats and potatoes for the support of their families, with small crops of flax, to give employment to their women. The average value of land is from 26s. to 30s. the acre.

The manufactures of Cavan make it a populous and flourishing county, and will in time contribute materially to the improvement of its agriculture. The fabric for which it is most celebrated is a thin linen, for the most part 7-8ths wide. The average sale of linen, manufactured in this county, is estimated at about 100,000*l.* per annum. Of late, however, the superior demand for cotton goods has induced the manufacturers of Cavan to direct much of their attention to the weaving of muslins.

This county is stated by Mr Wakefield to contain at least 6000 freeholders, one half of whom neglect to enrol their names. It sends two members to parliament; and as 700 of the enrolled freeholders are under the Earl of Farnham, and 300 under his cousin Colonel Barry, the Earl commands the return of one of the members: the other is independent, but the Protestant interest prevails in his election. By the latest return of the population of this county, it appeared that there were 20,808 persons capable of serving in the militia. A census, taken in 1797, states the number of houses at 18,056, from which, allowing five to each house, we may estimate the population at 90,280 souls. The proportion of Catholics to Protestants is as five to one; but as there is only one Catholic gentleman who possesses any extent of landed property, and as the Catholic tenantry are completely under the controul of their Protestant landlords, they have here no political interest, and the Protestant gentry are decidedly hostile to their claims.

In Cavan, as in most of the counties of Ireland, education is deplorably neglected. By a charter of Charles I., 570 acres were assigned as a fund for a school in Cavan; but by a survey, published in 1805, it appears that this school had then not a single boarder, nor is there any number of day-scholars mentioned. The Cavan militia has a regimental school, the regulations of which appear well calculated to promote their object. What private opportunities the county may afford for the education of its youth, we have not been able to ascertain.

This county contains 30 parishes, of which 26, with 24 churches, are in the diocese of Kilmore, three in the diocese of Ardagh, and one in that of Meath. It was formerly called East Breffney, and sometimes O'Reilly's county, from the Irish family which possessed it. It was forfeited at the beginning of the riegn of James I.; and a great proportion of it is still in possession of the descendants of those settlers to whom he allotted it. See Wakefield's *Account of Ireland, Statistical and Political*, 1812; Sir Charles Coote's *Statistical Account of Cavan*; and Beaufort's *Memoir of a Map of Ireland.* (*μ*)

CAVAN, the assize town of the above county, is a post and market town, but is in no other respect of any importance. Previous to the act of Union, it sent two members to parliament, but now has not the privilege of returning one. N. Lat. 54°, W. Long. 7° 16′. (*μ*.

CAUCALIS, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 159.

CAVANILLA, a genus of plants of the class Diœcia, and order Tetrandria. See Botany, p. 329.

CAUCASUS.

Caucasus, one of the 41 governments into which the Russian empire is divided. This government is subdivided into two provinces; Astracan, and another known by the same name as that of the government. Within the latter of these provinces is comprised the Cuban, and all the districts to the east and south, now in the possession of Russia, between the rivers Don and the Cuban, and between the Black Sea and the Caspian, extending as far as the confines of Georgia, and which is constantly receiving new accessions, in consequence of the reduction and submission of the wandering hordes. The same name of Caucasus is the common appellation by which the whole of the great ridge of mountains is distinguished that stretches between the Caspian and the Black Seas; and it is also the name of the very high mountain which constitutes the principal summit in this great and extensive ridge.

The Caucasian mountains are the most distinguishing feature in the region in which they are situated. They stretch from the mouth of the river Cuban in the north-west, to the outlet of the river Kur, into the Caspian Sea, in the south-east. There seems reason to believe, that a connected chain extends also from this ridge of mountains in a south-western direction, to the vicinity of the bay of Scanderoon, as at the other extremity of it other chains branch out into Persia, which they pervade from north-west to south-east. These latter ridges terminate in the deserts of the south-eastern part of that country, or at least are so imperfectly connected with the mountains of Hindoo-Koh, that it would be difficult to trace their junction. Much less can they be considered as an extension of Mount Taurus, which terminates at the Euphrates, and the deserts of Algezira. In this matter, therefore, the ancients judged erroneously, who regarded the principal chain of these mountains as a continuation only of mount Taurus, at the same time giving the name of Antitaurus to the connected branch already mentioned, extending from them towards the south-west. The chief notices as to other particulars relative to the Caucasian mountains, which occur in the works of the ancient writers, are as follow: By Strabo, they are represented as extending from the Euxine to the Caspian Sea, and including, as within a wall, the isthmus that separated these seas. Towards the south they had Albania and Iberia; on the north the level country of the Sarmatæ; and they abounded with various kinds of trees, some of which were used in the construction of ships. According to Herodotus, the commencement of this range of mountains was from the territory of Colchis, whence it proceeded onward till it became a boundary to the northern part of the Caspian Sea. This writer mentions also two passages in these mountains, of which, he says, that the Scythians and the Cimmerians availed themselves in their incursions into Upper and Minor Asia. Procopius takes notice of the same defiles, which he represents as situated in the eastern limit of the mountains, and to have been called by the names, the one of the Caspian way, the other of the Caucasian way. He adverts also to the use to which these defiles had been made subservient, in furnishing a road for the Huns at the times when they invaded the territories of the Persians and the Romans. The same defiles are mentioned, and in a somewhat similar way, by Pliny, Tacitus, and Lucan. The first of these writers takes notice of a project which it seems Seleucus Nicator had formed, of joining the Euxine and Caspian seas by a wall. This project, it is said, was executed under Antiochus Soter, or Antiochus Theus, but the wall sunk into ruin after the fall of the Seleucidæ. It is upon the mountain of Caucasus that the ancient mythologists report that Prometheus was bound, as a punishment for his crime of having stolen fire from heaven; in which state of durance, they add, he remained till released by Hercules. Strabo, and some other historians, relate, that the rivers of this mountain brought down gold-sand, which it was usual to collect in sheepskins. And it is stated by different writers, that even at those early periods, the inhabitants of these mountainous regions were very numerous, consisting, according to some, of 70, according to others of 300, different nations, who spoke various languages, and subsisted upon the flesh of wild beasts, fruit, and milk, having, on account of their uncultivated and savage manners, no intercourse with one another.

Of the whole range of the Caucasian mountains, extending in the manner that has been already delineated, from west to east, or rather in a direction between northwest and south-east from the Euxine to the Caspian, the length is stated to be about 350 or 400 English miles. As they approach the seas on each side, these hills decline very much in height. Throughout the range, where the elevation is greatest, there is a tract of about five miles in breadth, which is covered with eternal ice. The breadth of the whole chain on the northern declivity, extends at most to 50 miles, and runs along on the prodigious northern plain which, taken in the quadrature, measures 1000 English miles, being bounded on the east by the Siberian, and on the west by the Valakhian mountains. To the northward and southward of this tract of mountainous ground, the country, in all directions, is generally flat and level. The Marshal Von Bieberstein, who remained in these regions a considerable time, and was at the greatest pains to ascertain precisely every circumstance of consequence concerning them, states the extent of the Caucasus in length, from its western extremity at Ghækæ to Targhu, to be 95 German miles; its breadth, on the side adjoining the Caspian Sea, to be 53; in the middle, where the river Terek to the north, and Arakui to the south, form a division between its eastern and western parts, 96; and on the western side, along the Porta Cumana, a celebrated pass, 150 miles. The icy ridges of this mountainous tract, and indeed its ridges in general at their highest points, consist usually of granite. Immediately adjoining to these, both on the northern and southern sides, are mountains of slate. Farther on are hills of limestone or chalk, which terminate in sandhills. The main mountain, or rather the high ridge of the main mountain, from which the whole declines and sinks towards the two seas, seemed to Guldenstadt to be not more than from five to seven versts in breadth. This he describes as a granitic stratum, consisting mostly of a line of mounts, of a truly Alpine height, which, by reason of their local elevation, particularly in some open fissures, contain everlasting snow and ice, generally exhibit bald rock, without any covering of earth or plants and trees, and in some parts pierce into the clouds. The extension of this principal ridge towards the two sides, measured from north to south, or right across, he reckons, on an average, to be 70 versts; and the north side, he observes, is visibly steeper or higher than the southern, as it declines in a far narrower or smaller breadth, or rather only sinks down towards one part. The limestone mountains mentioned, run in a flat clayey field, of 20 miles in breadth, gradually declining till they end in a promontory 10 miles broad, which consists almost wholly of sandstone, and that again runs out afresh in a clayey plain about eight miles broad, in which there occur numerous sandstone hills. In this plain there abound common salt and natron, and in the promontory, and its continuations, there are found sulphur, sulphur-pyrites, warm sulphureous springs, iron-stone, vitriol, petroleum, rock-salt sources, nitrous salts, bitter salts, magnesia, vitriolata, alum, selenite, &c.; also some petrifactions, chiefly in flint. Specimens of lead and copper are rarely seen in the promontory, but often in the higher mountains. The slate of this district contains alum. There appears in it also ceruse of lead, in which there occurs silver and copper pyrites, in courses of quartz and spar. Courses of bleyglantz are seen in particular situations, likewise other lead ores, and various ores of other kinds. In the upper regions, it is remarked that the river Hippus, in Iberia, yields gold, that the mountains in these parts are very rich in minerals, and that the gold mines at Cumana were wrought by the Romans. The mountains on the Kura, especially in the district of Azghur, likewise contain very rich ores, and in the plains adjacent to that river, there are found fine marble, coal, and warm springs. In the mountains bordering on the Terek, as far as the village Stephantzminda, there occur lead, silver, and iron ore. In the Georgian province Somghetia, rich silver and iron ore, marble, and jasper, are met with; in the circle of Quoetsh, copper ore; in the principality of Tamblut, rich lead, silver, and gold mines; in the principality of Lori, considerable copper mines and good mill-stones; in the principality of Unsular, rich copper-mines; in the parts about Akdale, gold, silver, and copper; and in the province of Albania, marble and alabaster, iron, warm baths, petroleum, and rock-salt. Thus it appears that, in the highest points, the Caucasian chain of mountains is covered with snow and ice; and that this chain having its highest, middle, and fore-mountains or promontories, the sides of it generally are very rich in minerals; and, probably, in those parts which are now added to the Russian empire, contain a treasure of the precious metals. The elevation of this ridge is, on the whole, very considerable, and many of the rocky parts are extremely steep and prominent.

Professor Pallas, in his observations during a journey along these mountains, takes notice somewhat particularly of three of them that occur, two in the immediate vicinity of each other, and the third at a greater distance, and which, rising one above another in height and importance, may be considered to exhibit specimens of the principal altitudes that occur in this tract, as the account of them may be of use towards giving a more accurate idea of the conformation and aspect of the range of country. The lowest of those heights to which he has had occasion to advert, is the Metshuka, situated, he remarks, on the common and extensive basis of the Beshtau and its adjacent hills. This mountain borders on the Podkuma, about 5 versts north-west below Constantinogorsk. It is a calcareous mass of considerable extent, and in a conical form. It is richly covered with wood, and apparently more than one-third part the height of the lofty Beshtau. It consists of a greyish, firm, calcareous mineral, without petrifactions, not unlike the hornstone, and which is disposed in tolerably thick horizontal beds. It has an appendage on the anterior side, consisting of a species of tophus, and in the centre of its summit there is a deep cleft like a valley, overgrown with wood. From the foot of the mountain a steep and narrow ridge, consisting of an uncommonly beautiful white tophus, extends along the low country of the Podkuma to the west, and in a curved direction towards the north-west, not unlike a promontory. This ridge divides itself at the western extremity into two branches, one of which extends directly to the west, runs nearer to the river, is upwards of 200 paces longer than the other, and appears to be a more ancient production of the sulphureous waters. The direction of the shorter branch is, so far as it extends, more north-westerly. They are both plentifully covered over, and ornamented with various kinds of rock and other plants. On the southern side of the whole ridge, there were observed here and there some as it were rounded projections of tophus, disposed in successive laminated strata, which appeared to owe their origin to small springs, or channels of lime-water impregnated with sulphur, and some of which still continued to run, while others were then in a dry state. These strata, as well as the whole mountain, decline abruptly towards the low country.

The Beshtau, the next mountain, and next in elevation to the one now described, is remarked by the same writer, to be frequently enveloped in clouds to its very base, while the summit even appears to project over them. This mountain is situated on a level and very extensive eminence, rising much above the current of the rivers Kuma and Podkuma, together with several adjacent mountains, among which the Metshuka, just noticed, is one of the nearest and most considerable. That eminence presents no species of rock, except the very ancient limestone which forms the whole of this mountainous tract, and has scarcely any petrifactions. It occupies the whole space between the two rivers, and produces no trees but those growing on the four contiguous mountains. In the back ground these are connected by what is called the Asses' Ridge, and form between them a large glen or valley; from the midst of which, and the loftiest of the whole species, rises a fifth mountain, reaching the clouds with its summit. This is of a conical or rather angular form, and so narrow on its top, that scarcely ten persons have room to stand by each other. From that point, several narrow ridges extend towards the four adjacent mountains; to which circumstance the name is apparently owing, by which this mighty mass is designated of Beshtau, or the five mountains. Towards the top of the mountain the wood, which abounds on all or most of the adjacent hills, begins to decrease, and to degenerate into dwarf trees. Mingling with, or rising above, these, in respect of their position, there occur numerous shrubs, chiefly of the beautiful kind; the *azalea pontica*, which last is finally succeeded by the barren summit of the eminence. From the top of the Metshuka, it is perceived that the mountainous tract which connects the Beshtau with the principal adjacent heights, appears to run chiefly in a direction with the stream of the river Kuma already mentioned; the eminences rising progressively as they extend towards the south-west, till they unite with the Elburus, situated near to the sources of the river Cuban.

The Elburus is the most distinguished of the eminences that seems to have attracted the attention of Professor Pallas in this quarter. The account which he gives of it and of the adjoining elevated ridges is as follows. "From Madshary," says he, "we first descried the snowy mountains of the Caucasus. During the whole of this day's journey, they appeared particularly distinct to us on account of the serenity of the air, and exhibited in their train a most magnificent spectacle. Besides the lofty and colossal Elburus, which towered above all the others, and as it were guarded the whole chain on its western extremity, there were four principal groups crowned with snow, which were particularly conspicuous by their irregular summits. The black mountains, or as they are usually called here Tshernye Gory, appeared at this distance like a regular wall which connected the snowy mountains that rose above it, while it formed their basis. The height of these black mountains is apparently equal to that of the Beshtau, though the latter is 150 versts distant from the former; and that part of the Elburus which is covered with snow appears to be above double the height of the Beshtau, which, however, is much nearer the place whence we viewed these vast piles. The other groups of these snowy mountains appear to the eye one-third lower than the Elburus: the most conspicuous are the broken mounts near the rise of the Aredon, and the summits of Kasibek beyond the source of the Terek." In a note it is remarked, that the Elburus is not inferior, perhaps, to Mont Blanc. The different surrounding tribes, it seems, distinguish it by different names. From what particular nation it has received the name of Elburus has not been ascertained. But in those parts it appears to have been pitched upon as a fit object with which to connect some of the notions of the prevailing superstition. It is considered as the residence of the king of the hobgoblins, distinguished by the appellation Dshim Padishah: and in the vicissitudes of an unfortunate war, it serves as an asylum to the discomfited nations. The most considerable of the mountains, it is observed, which form a chain with the Elburus, are Ketsuergan, Birmamut, and Auar-setsh, which lie near the sources of the Kuma and Podkuma: between these and the Baksan there are, towards the east, Mount Urdi, and the mountains of Kanashall, as well as several others. Towards the north and east of the Beshtau, an extensive plain presents itself to the eye, over which there is, in clear weather, a prospect even as far as Kislar and the Caspian Sea.

It has already been remarked, that the Caucasian mountains contain abundant stores of various valuable minerals. There is diffused in the same quarter a copious supply of other kinds of natural wealth, equally deserving of attention. Many of the vales in this district are extremely fertile; and an abundance is every where within reach of some of the substances, from which the most effectual aid may be obtained towards exciting the principles of fertility inherent naturally in a soil, or adding to those which thus even in their original state they possess. There are found here, in different quarters, arable land of an excellent quality, meadows, pastures, and extensive and valuable tracts of woodland; which last produce the finest forest-trees of various kinds, furnish an inexhaustible supply of fire-wood, and by affording places of refuge for a profusion of useful game, make amends for the inconvenience with which, indeed, also they are in some degree attended, of offering haunts to animals of prey.

In the same tract of territory, several important rivers run in different directions; such as, on the Russian side of the mountains, the Terek, the Cuban, and Kumma; on their southern quarter, by which they are connected with the Persian dominions, as well as more immediately with several other less considerable states, the Rian, the Kur, and the Aras. The whole region, too, is intersected in all its parts with a vast profusion of minor streams, tributary to these or other considerable rivers.

Amongst the other divisions of their natural productions deserving of consideration, may be reckoned the mineral waters that have been discovered in some of the Caucasian mountains. These occur chiefly upon or in the neighbourhood of the Metshuka, already mentioned, and the immediately connected hills. The first of them that may be noticed, is a cold spring, situated in the vicinity alluded to, and at the distance of 35 versts from the fortress of Constantinohor, towards the N. W. It has its origin in a kind of pit, between two rivers of fresh water, issuing from several crevices in the rocks. Thence the limpid mineral water rushes forth with a violent motion, continually ejecting large bubbles, together with a ferruginous brown and sleek sand, thus perfectly resembling coffee in a state of ebullition. The violence with which this sand is forced to the surface is more or less considerable at different times, and frequently on immersing a glass a little way downwards, it may be taken out more than half full of it, but as it is immediately precipitated, the effervescent water then appears as clear as crystal; and even in the spring itself, the sand by its own weight falls to the bottom, so as not to be carried into the channel of the bason. The great mass of water that is sent forth from the extensive cavity, through which immediately the fluid is brought into contact with the external air, having foamed about for some time, and thrown up its sprays in various directions, is finally discharged, by the hollow channel mentioned, into one of the rivers by which it is surrounded in the form of a semicircle. Its junction with this, and through it with the other body of water, though each of these be more considerable than itself, is yet attended with the remarkable effect, that the barbel and trout, which are very numerous in the upper parts of those streams, cannot exist in the places where they receive this mixture: an effect to be attributed, no doubt, to the remains of carbonic acid in this mineral water, and of which, in the upper parts of the spring where its force is more entire, the influence is such, that fish taken and plunged into it immediately float motionless on the surface, and recover but slowly when replaced in the water of the rivulets.

The stream proceeding from the mineral source is distinguished, in the language of some of the adjacent tribes, by the name of Nartzan, or Nar Tzana, which name, after its junction with the contiguous rivulets, it communicates also to them, so that for some length in its course, the same continues to be the appellation of the whole body of these united waters. The spot whence primarily the Nartzan derives its origin is contained in a valley situated at the foot of lofty mountains of limestone, by two high ridges of which description the valley is nearly enclosed, while it is fronted by a third of greater elevation than either of the others. The source of the spring may perhaps be found to be in a horizontal line of sandstone below the calcareous strata of these surrounding mountains, and from which bed it is that it appears to convey with it the brown sand. The traces of the actual existence in this quarter of such sandstone may be perceived in various places in the vicinity, as well as the fact legitimately inferred, from different considerations that will suggest themselves to the attention of the careful observer.

In addition to the principal source, the mineral water in question is transmitted also through several inferior veins of different sizes, some of which occur here and there in the shallow parts of the bason itself. On plunging the hand into this water, no remarkable sensation of cold is felt; on the contrary, it seems in some veins to be luke warm, particularly during the cold air of the morning. It appears cold, however, when drunk, especially when the heat of the sun promotes its evaporation, and thus imparts to it a degree of freshness. If it be drunk while the body is heated, it has an effect on the stomach similar to ice. The thermometer of Reaumur indicates in it a temperature of about 10 degrees, when the atmosphere is at 16. It stimulates the tongue with an agreeable acid taste resembling that of Seltzer water, a quantity of the carbonic acid equal to that contained in the strongest of which waters it still continues to hold, notwithstanding its disposition to part with a great proportion of that with which it is originally impregnated, and is in fact supersaturated. When recently and properly drawn, it has a briskness equal to that of the best Champagne wine; and if put up with due care for keeping, it will remain for any length of time fresh and clear, notwithstanding the magnesia contained in it. It effervesces with all kinds of wine, and in general may be drunk in any quantity at pleasure without danger. It has been examined by different persons capable of judging of its merits, and some of whom were sent purposely by government to ascertain its nature; when the result, it is said, proved it to be in reality possessed of medicinal virtue. It is reported evidently to refresh and invigorate the body, insomuch as to have produced wonderful effects on several sick and debilitated persons. It is stated to be of the greatest efficacy in hæmorrhoidal obstructions, after inveterate fevers, and the subsequent chronic complaints thence originating, as also in cases of the suppression of the menses, and similar indispositions which are frequently the forerunners of disease. There seems, moreover, reason to believe, that if brought into more general use, so that its properties might become better known, it would be found serviceable also in various other maladies.

For its remarkable briskness, the water of this mineral spring seems to be indebted chiefly to the carbonic acid, saturated with lime and magnesia, as well as to the salts which it holds in solution. When placed on a very gentle fire, it speedily boils with great agitation, immediately begins to grow turbid, and deposits a white sediment. From 16 pounds of water, the dry sediment obtained by evaporation weighed 2 drachms and 20 grains. This sediment loses, in the process of drying, about 7 grains. The result of the chemical analysis of it by M. Lovitz the academician gave, from 133 grains, the following ingredients: Of muriate of magnesia, 1 grain; Glauber's salt in a dry state, 46; vitriolated magnesia in ditto, 25; muriate of soda, 10; carbonate of lime, 26; carbonate of magnesia, 10; carbonate of iron, 2; sulphate of lime 13. From 20 pounds (apothecary's weight) of the water, subjected to a similar analysis, the following were the ingredients obtained: Of carbonic acid 580 cubic inches; of carbonate of lime, 87 grains; of carbonate of magnesia, $12\frac{2}{5}$ grains; of carbonate of iron, $2\frac{3}{5}$; of sulphate of soda, $53\frac{1}{3}$; of sulphate of lime, $41\frac{4}{5}$; of sulphate of magnesia, $27\frac{7}{15}$; of muriate of soda, $27\frac{23}{26}$; of muriate of magnesia, $2\frac{33}{41}$; of resinous extract, $\frac{1}{4}$.

In the vicinity of the spring of Nartzan, and at different elevations in the mountain Metshuka, before described, there occur several important springs of hot sulphureous water. The first of these rises from the round extremity of the principal but shorter ridge, already mentioned as constituting one part of a sort of continuation connected with that mountain. Near the source of the veins, by the contributions from which this spring is formed, a bath has been hewn in the tophus stone, and contiguous to it a small chamber has been built of wood for the use of bathers. At a quarter height in the mountain, in an open cleft, upwards of a fathom broad and deep, by ten arshines in length, there is found another natural hot-bath, of a temperature rather higher than that of the inferior spring: this extends into the rock of sandstone towards the east, is six feet wide, nearly ten fathoms long, and has a smooth vault not unlike an artificial grotto. This is the place resorted to by the Turcoman women for bathing, while their husbands make use of the lower bath. At still greater heights than these, and rising progressively one above another, there occurred three other springs of a similar description and character with those just mentioned. With regard to the water of them all, the smell of the sulphur, perceptible at a considerable distance, the snow-white tophus stone, of a crystalline nature, which is here very frequent, and the flowers of sulphur precipitated in the channels of the descending water, are sufficient indications of its principal constituents. Even after it has run probably over the whole length of the tophus ridge, this water is yet in the most distant springs hotter than the hand can bear, and causes the mercury to rise in the thermometer of Reaumur $57\frac{1}{2}$ degrees, or 162 degrees of Fahrenheit. The abundant calcareous sediment which it deposits, is, at first, and continues for some time afterwards, as soft as pap, in which state it is used by the Circassians, and other tribes, for whitening their houses. In a bed of this substance, which is four or five inches thick, needles of the spath kind are gradually produced: and this crystallization becomes more and more frequent, as well as compact, till at length the whole bed is converted into a heavy snow-white tophus, that exhibits pores and almost perpendicular needles in its fracture. This species of tophus is acted upon by the nitric acid, which causes a violent effervescence, so that the stone is completely and speedily dissolved: if exposed to fire, it discovers no perceptible trace of sulphur. Every pound of the sulphureous water last mentioned contains upwards of 16 grains of a white earthy sediment. The water itself has a slightly styptic, sweetish taste, and evidently contains a portion of alum, which renders it serviceable in diarrhœas and dysenteries, particularly when the first passages have previously been evacuated. In rheumatic pains, cutaneous eruptions, and inveterate ulcers, it is of essential service, if used as a warm bath. Gouty and paralytic patients have recovered by its use. But in intermittent fevers this bath ought not to be resorted to, as it is apt to occasion dangerous obstructions.

In 1801 an account was given by Mr Simpson, a chemist, of a warm spring discovered in the chain of the Caucasian mountains, five versts north-east from the fortress of Constantinohor, and forty from the first mentioned cold spring. It runs straight towards the west, down the steep declivity of a chalky, shelly, and curiously coloured mountain, falls from the height of forty-four yards, divides itself into small rivulets, and entirely disappears at the foot of the mountain. Another report was made during the same year, concerning the Caucasian mineral waters, by the general Obriezkow, in consequence of which Drs Hordinsky and Krushevitch, and Mr Skwentzon, a chemist, were sent thither for the purpose of procuring such precise and satisfactory information respecting them as might serve to determine government whether any, and what steps ought to be adopted with a view to turning them to useful account. At the same time, accordingly, Mr Skwentzon was employed in ascertaining the nature and the composition of the two springs just alluded to, the medical gentlemen applied themselves to discover their proper use and application, and in making practical experiments on different individuals of both sexes. The substance of their accounts, in some of the particulars of which, it will be perceived, that they have been anticipated in the observations already introduced, is as follows:

The temperature of the hot spring, during the warmest parts of summer, is, in the evening, from 35 to 37 degrees in Reaumur's thermometer. The quantity of water discharged in three minutes and 15 seconds, is 3580 lb., and its weight is equal to that of distilled water brought to the strength of a mineral water. It has a smell of sulphur, and contains sulphuric and carbonic acid; after the evaporation of 300 pounds, till the vessel was quite dry, there remained 12 oz. 7 dr. and 35 grs. of solid matter. The water of this spring is good for curing eruptions of the skin, intermittent agues, scorbutic, chronical and venereal diseases, dropsy, and long standing rheumatisms.

The cold spring, according also to Reaumur's thermometer, has at all times 10 degrees of temperature. The weight of its water to that of distilled water, is in the proportion of 50 to 30. It is very transparent, has a sharp acrid taste, and a smell of carbonic acid, which substance enters into its composition; after the evaporation of 400 pounds of it by boiling, there remained 9 oz. and $1\frac{1}{2}$ dr. of solid matter. The effect of this water, whether drunk, or only applied externally, is very beneficial in chronical rheumatisms, in cases of general debility occasioned by venereal excesses, in hæmorrhoids, king's evil, ring-worms, palsy, internal obstructions, and in all diseases where it is necessary to stimulate and strengthen the action of the vitals.

The composition of this latter, or the cold spring of Constantinohor, as found by Mr Skwentzon, is that which has been already given. In 20 lb. of the water of the warm spring, the ingredients, according to the result of his analyses, are these; of carbonic acid, $106\frac{2}{3}$ cubic inches; of sulphurised hydrogen gas, 80 gr.; of carbonate of lime, $99\frac{2}{3}$ gr.; of carbonate of magnesia, 17 do.; of sulphate of soda, $101\frac{20}{57}$ gr.; of sulphate of lime, $31\frac{2}{5}$; of sulphate of magnesia, $06\frac{6}{19}$; of muriate of soda, $156\frac{7}{13}$; of muriate of magnesia, $1\frac{1}{2}$; of resinous extract, $\frac{1}{4}$.

Mr Skwentzon having ascertained the principal component parts of the two springs in the Caucasian mountains, which chiefly engaged his attention, drew up and produced, upon his return home, a comparative table of their ingredients with those of other celebrated mineral waters; and government have spared no expence in rendering them convenient places of resort.

The mountainous regions of Caucasus have been, from time immemorial, and still are the habitation of bold and valiant warriors, who have, with determined resolution, resisted the reiterated attacks of the Mongols, Arabs, Persians, Tartars, and Russians, and maintained, in a considerable degree, their freedom and independence. On the most elevated parts at the same time even of these vast ridges, and in vallies almost inaccessible, there is found, along with these, a singular mixture of small people of various denominations, differing from one another, most probably in origin as well as in language, but with respect to whom many of the circumstances that appear most curious and out of the common tract, do not easily admit of any tolerable explication. The distinct and appropriate languages spoken in this quarter, are said to be numerous, and to branch out into an incredible diversity of dialects, some of which deviate so entirely from the known languages of Asia and Europe, as to admit, in no degree, even of comparison with them; some are known languages, without any foreign admixture, and there are others which seem to consist of a mixture of several known ancient languages, such, for example, as the old Georgian, the Mongolian, the Persian, the Arabic, and the Tartarian.

It will be understood, from the circumstance of the languages just named having been introduced, more or less, among the inhabitants of the Caucasian mountains, that, though not subdued, the original inhabitants of those parts have not escaped all commixture with different foreign tribes. In fact the population of these regions, generally considered, may be held to consist chiefly of mingled races, made up partly of the primitive settlers, partly of colonies of those nations by whom, at different times, they have been more or less brought under subjection. From the difficulty, however, of ascertaining precisely the primitive stocks from which all the descriptions of persons that occur here, or rather the tribes or branches of tribes that constitute the population of those mountains, have been derived, it has been usual to comprise them all, with the exception of the Georgians, under the general denomination of the Mountain-Tartars. This subject has been involved in obscurity, in consequence of some writers having admitted almost as many different races of people, as there are principal names of tribes and families. Guldenstadt is the first who had the merit of endeavouring to reduce the small scattered tribes which occur in these parts to certain classes, and of combining the names belonging to a particular tongue, by collecting accurate vocabularies. Professor Pallas, proceeding upon his plan, has given a pretty distinct and satisfactory account of the nations inhabiting the northern parts of the Caucasus, to which nations, it is to be observed, he has chiefly confined his attention, as being those most intimately connected with Russia, and which, at different periods, had in a great measure acknowledged its sovereignty

The following are the tribes comprehended in his enumeration:—

1. The small Abasa, or Altikesek. Under this general designation are reckoned six subordinate divisions, viz. the Shantemir, the Klitsh, the Kesha, the Lou, the Bibert, the Dudaruk. The people of this tribe inhabit the country between the rivulet Maraukh and the river Podkuma, consequently occupying a part of the Turkish and part of the Russian frontiers. They do not submit to the government of princes, but are ruled severally by the elders of their subdivisions. At a former period they were Christians, but their nobles now profess the Mahometan religion. Agriculture is not unknown amongst them, but they maintain themselves chiefly by the rearing of cattle, and they possess a beautiful breed of horses.

2. The great Abasa, who occupy a considerable tract of territory stretching generally to northward and westward of that just mentioned. The subdivisions comprehended under this appellation are, the Beshilbai, the Barakai, the Tubi and Ubukh, the Shapsikh, the Natukash or Natkhu-Kaitshians. Agriculture and the rearing of cattle are a little attended to by some of those belonging to this tribe, but generally they are much neglected. The Beshilbai rear a few goats and sheep, and pay great attention to the cultivation of bees. The Natukhassians cultivate a small quantity of rye, and occasionally keep hogs, animals rarely met with among the other nations inhabiting this country. The several divisions of them are given to dissensions amongst themselves, and many of them devoting themselves to a predatory life, obtain by this means a hard-earned and precarious subsistence.

3. The warlike nation of the Circassians inhabit principally the promontory of the Caucasus, extending themselves also to the adjacent beautiful plain, from which they have expelled the ancient inhabitants, and subjected the greater part of them to their dominion. From the superior importance of this tribe, it has been usual, though improperly, to comprise under the same appellation, several of the contiguous and less important tribes. But the people, in strictness, thus designated, are those who inhabit the part of Caucasus, called the Great and the Little Kabardia, the islands of the lower Cuban, and the southern bank of that river. They denominate themselves Adege, *i. e.* islanders; by the Russians they are called Tscherkessi, and by the rest of Europe by the name here given to them of Circassians. See CIRCASSIA.

4. The Nagais, or the Tartars of the Cuban, who dwell among the Circassians, as well as in their vicinity, and generally lead a pastoral life; they are the remainder of the Mongolian Tartars, formerly a powerful people, who, after the reign of Zengis-Khan, invaded and governed part of Asia as well as Europe, but have, during the last century, been so much reduced by the vicissitudes of war and their own turbulent conduct, that at present they scarcely deserve the name of a nation. They occur, however, in small numbers, in different parts of the region under consideration, and are subdivided into the following principal branches: the Naurus, the Kassai, the Kaspolat, the Kantshak, the Mangut, or Mansgut, the Gedissau, the Dshamboiluk, and the Gibshikul; they are a restless unsettled people, whose disposition to robbery has been little reduced, notwithstanding the severity of the punishments to which they have been subjected. Their principal means of support are their

flocks, though a little attention is also paid to agriculture, particularly to the cultivation of millet.

5. Several separated branches of the Nagais and Tartars, are scattered on the mountains of the Caucasus, viz. the Kumyks, the Terekemes, the Karatashais, and the Tshegems. These people are nearly in the same state of society with those previously mentioned.—Christianity seems at one period to have made some progress amongst them. Their attention is chiefly directed to some branches of agriculture, to the rearing of their herds and flocks, or to the produce of honey. They turn also to some account others of their natural productions, such as iron, lead, nitre, and the skins of wild animals. One of the divisions of this people, the Tshegems, have received from some writers the name of Zekhi, from the analogy of which name it has been conjectured that they were originally Bohemian fugitives.

6. The Ossetes, or Ir, and according to their own denomination Rones, are a very peculiar people, who, having been compelled to retire to the interior parts of the high mountains, have, for their boundary towards the north, the Caucasus, towards the west the river Urup, to the east the Terek, to the south west the river Rion, or Phasis of the ancients, and to the south east Aragva. The whole tribe is divided into districts, or Kom, and villages or Kou. It is observed that the tongue peculiar to these people has many words in common with the Persian, German, and Sclavonic languages, as well as expressions analagous to the dialect of these nations. The Ossetes are a barbarous, predatory, and miserable race of men, who have always infested the public road leading to Georgia through the mountains which they inhabit. The two most populous and powerful of their districts are those of Dugor and of Durdugor.

7. The Lamur, Galgai or Ingushians, differ entirely from all other inhabitants of the Caucasus, in language, as well as in stature and features. Their manner of pronouncing is as if their mouths were full of stones; they are said to be an honest and brave set of people, who maintain their independence, and are subject only to their elders or priests, by whom their religious sacrifices are performed. They are almost the only nation inhabiting the Caucasus among whom the shield has been preserved as a part of their accoutrements. They are excellent marksmen, but giving little attention either to agriculture or the rearing of cattle, they are consequently in a state of poverty; they live in the vicinity of the sources of the rivers Kumbelu and Sunsha, and extend their habitations along the high mountains of the eastern bank of the Terek, where they border on the Ossetines. The Karubulakes likewise border on the Ingushians towards the west, and on the Tshetshentzes towards the east. These three last communities speak nearly the same language, which is not known to have the least analogy to any other dialect except that spoken at Tusnet: in respect of this similarity, the judicious Guldenstadt has thought fit to class them altogether under the common denomination of Mitzdshegis or Kesti, who appear to be the remainder of the true Alanians. They are by no means, however, of the same national character—the Tshetshentzes, indeed, differing so radically from the Ingushians, as to be justly considered the most turbulent, hostile, and predatory inhabitants of the mountains.

8. Of the Suani, like the last mentioned people, a race of mountaineers, the habitations on the southern basis of the Elburus, extend to the west as far as the source of the Engur; towards the south they border on the principality of Dadian, and the Imeretian province of Odishi, towards the east, on the source of the Tzenis-tzkale or horse river, the Hippus, undoubtedly, of the ancients. They live dispersed in particular families, are great depredators, yet call themselves Christians; they pay some attention to agriculture and the rearing of cattle. Their principal intercourse is with the provinces of Imeretia and Mingrelia. The amount of their population is not exactly known, but it appears not to be considerable.

In the Caucasian mountains, besides the tribes which have thus been enumerated, there occur several others; the Lesgisiens, who inhabit the province of Lesgistan, in the eastern Caucasus, between Kakhetty and Daghestan; they are divided into 27 stems, and are totally independent. The Taulintzians, who occupy the summits of the mountains, are also divided into several petty tribes, and acknowledge the protection of Persia. The Ainberlinians, who dwell in the vallies formed by the mountains of Ghilan, and, though they often change their patron-sovereign, have recently owned a subjection to the Persian monarch. Among the modern inhabitants of the environs of the Caucasus, may be also included those Kozaks of Russia, or other colonists, who have been recently settled along the banks of some of the principal rivers, chiefly those in the north, and who serve as a cordon to check the incursions of the native predatory tribes. For an account of the Georgians or Grusinians, the most numerous and powerful body of the inhabitants of these mountains, see the article Georgia.

The appellation by which the whole of this mountainous range, the highest and most extensive in the northern part of Asia, is distinguished, that of Caucasus is supposed to have been transmitted to the Greeks, in consequence of their intercourse with the Persians. In the language of this people, *cau* or *coh* signifies a mountain, whence, it is said, was formed *coh cas*, or the mountain of the Chasas, an ancient formidable tribe who inhabited the immense tract extending from the eastern limits of India to the confines of Persia, and probably as far as the Euxine and Mediterranean seas. Captain Wilford informs us, (*Asiatic Researches*, vol. vi. p. 455.) that the Chasas are often mentioned in the sacred books of the Hindoos. Their descendants still inhabit the same regions, and continue to be called by the same name. They belonged to the class of warriors, but they have been degraded, agreeably to the institutes of Menu, in consequence of their omission of the holy rites, and of seeing no Bramins. Isidorus (*Orig*. l. 14. c. 28.) says, that Caucasus, in the eastern languages, signifies white; and that a mountain close to it is called Casis by the Scythians, in whose language it signifies snow and whiteness. See Pallas's *Travels through the Southern Provinces of the Russian Empire in the years* 1793—4, vol. i. Tooke's *View of the Russian Empire*, vol. i. Campenhausen's *Travels through several Provinces of the Russian Empire*, &c.; and De Biberstein's *Tableau des provinces occident. de la Mer Caspienne*, Petersburg, 1798. (K)

CAVEAT. See Patent.

CAVERNS. See Antiparos, Derbyshire, *Isle of* Sky, &c.

CAVIAR, the name of a kind of food prepared from the roes of fish, and forming an important article of Russian commerce. See the article Caspian Sea.

CAULINIA, a genus of plants of the class Monœcia, and order Monandria. See Botany, p. 313.

CAULIS. See Botany, p. 32.

CAULOPHYLLUM, a genus of plants of the class Hexandria, and order Monogynia. See Botany, p. 188.

CAUSATION. See Metaphysics.

CAUSTIC. See Surgery.

CAUSTIC Curves. See Optics.

CAUSTIS, a genus of plants of the class Triandria, and order Monogynia. See Botany, p. 107, and Brown's *Prodromus Plantarum Nov. Holland.* &c. p. 239.

CAYENNE, or French Guiana, a province of South America, situated between 1½° and 5½° N. Lat. and 51° and 54½° W. Long. It is bounded on the west by Surinam, on the north and east by the Atlantic Ocean, and to the southward by the Portuguese territories, whence, as far as its boundaries have been defined, it is separated by the course of the Oyapoco. The extent of this province is computed to be 350 British miles in length, by 240 in breadth. Its immediate limit towards the west is the small river Amano, and on the east that called Aracara.

The project of forming a settlement here was first entertained in the year 1635. A report had prevailed for some time before, that, in the interior parts of Guiana, there was a country known by the name of El Dorado, which contained immense riches in gold and precious stones, more than had been found even in Mexico and Peru. This fable having fired the imaginations of every nation in Europe, it is supposed that it was in quest of the ideal country which it brought into view that Sir Walter Raleigh proceeded on his last voyage. The French were not behind their neighbours, in their endeavours to find out so desirable a country; and in the progress, or in the result of the attempts set on foot for this purpose, a substitute, however inadequate, was found by the adventurers, in the possession of a part of the province of Cayenne. Merchants of Rouen were the chief patrons of the scheme of colonising this province. The contempt for justice, which appeared in the conduct of the French, was here fatal to their interests. The native Indians, expelled from their lands, without even an attempt at consent or purchase, robbed of their huts for the accommodation of strangers, deprived of the society and labour of their women by the seductions or violence of the whites, and often compelled to toil for their oppressors, conspired against the intruders, murdered the governor, and greatly harassed and thinned the settlers. A new company was established; but unfortunately, the Abbé de Marivault, a man of great virtue, who had been a principal mover in this business, and who was to succeed to the office of governor, was drowned as he was stepping into his boat. Roiville, who was to have sustained the part of general, was assassinated during the passage. Those who arrived at Cayenne displayed there the same insubordination and atrocity which had broke loose on ship-board. They quarrelled with each other, with the former settlers, and with the natives. Many died of wounds, more of the climate. The garrison deserted to the Dutch. The savages, roused by numberless provocations, fell upon the remainder, so that those who clung longest to their properties were obliged to fly, and thought themselves happy in being able to escape to one of the leeward islands in an open boat and two canoes. The settlement thus abandoned, fell for a short time into the hands of the Dutch, but it was, in 1663, on the formation of a new company, wrested, through the vigorous interference of the French government, out of their possession. In 1667, it was taken by the English, and again by the Dutch in 1676. Finally, it was restored to the French on the conclusion of a peace. Soon after this period, some pirates, laden with the spoils they had gathered in the South Seas, came and fixed their residence here, resolved to employ the treasures they had acquired in the cultivation of the lands. In 1688, Ducasse, an able seaman, having arrived with some ships from France, proposed to those people the plundering of Surinam. They were, without much difficulty, induced to enter anew upon their early mode of life; and many of the other colonists took part also with them in the expedition. It was however unfortunate; some of the assailants fell in the attack, the rest were taken prisoners, and sent to the French Caribbee Islands, where they settled,—a loss which the colony did not afterwards recover. Soon after the peace of 1763, the court of Versailles, influenced by the Duke of Choiseul, used vigorous endeavours to restore or to increase the importance of this province. For that purpose, 12,000 men, engaged in France as labourers, were landed in the adjacent isle du Salset, and on the banks of the Kourou. But no habitation or proper provision having been prepared for this multitude of people, and arriving, as they did, at their places of destination in the commencement of the most rainy season of the year, when they could neither find subsistence nor employment, great numbers of them quickly fell victims, as was then alleged, to the insalubrious climate. A million sterling was uselessly expended on this enterprize; and that prejudice which ought to have attached to the manner of conducting the affair having been transferred to the country, government was prevented for a time from paying the least attention to it, and a number of Europeans and inhabitants of the West Indian islands, who might otherwise have thought of doing so, were deterred from settling in Guiana. The force of the mischievous prejudice alluded to, has however subsided by degrees; and, from the peace of 1783 to the Revolution, the French government was meritoriously attentive, by the introduction of new articles of cultivation, and by other means, to the improvement of this valuable district.

The coast of Cayenne is generally low and marshy, and subject to inundations, from the number of rivers which rush down the mountains with great impetuosity. The soil is in many parts uncommonly fertile, though in others it is dry, sandy, and soon exhausted. The productions are on the whole of an excellent quality; and it is easy here to gain a subsistence. The Cayenne pepper is a noted article of the produce. This is the fruit of the *capsicum baccatum*, gathered when ripe, dried in the sun, then pounded and mixed with salt. It is sometimes baked with a small addition of flour; and the biscuit rasped into powder, is sent to Europe. Owing, at the same time, to the disposition of the inhabitants to indulge to excess in the use of this article, a considerable quantity of it is even always imported from Peru. The subject to which the colonists first directed their attention in this quarter, with a view to profit, was the arnotto. Thence, they proceeded to the culture of cotton, indigo, and sugar. The coffee tree was brought from Surinam in 1721, by some deserters, who thus purchased their pardon. Cocoa was planted ten or twelve years after. Maize, cassia, and vanilla, have also succeeded, though not very conspicuously, at Cayenne. Several kinds of grapes have been lately introduced; and a wine is made there, said to be peculiarly medicinal in fevers. The state of the population, and production of this colony, stood thus in 1753: The number of whites were 500, who employed 1500 negroes and 1200 native Indians, and raised about 260,000 lbs. of arnotto, 80,000 lbs. of sugar, 18,000 lbs. of cotton, 27,000 lbs. of coffee, 92,000 lbs. of cocoa.—They exported also upwards of 600 trees for timber, and 104 planks. The same was still nearly the state of things in 1763. The cultivation of indigo, which at one time was carried on very successfully here, afterwards sustained a considerable diminution.

The island of Cayenne, or Cayanno, which, as it forms but an inconsiderable part of the whole province, though it has been frequently, yet has erroneously and improperly been confounded with it, is separated from the continent only by two arms of a river of the same name. Northwards it is formed by the sea, in other directions by the river mentioned, together with the Ouya and the Orayu. It is about 18 miles long, and eight or ten broad. The situation of this island makes it a most unfit place for a settlement; and it would probably have fared much better with the colonists, had they, instead of taking up their residence in it, in the first instance, commenced their operations on the main land. The part of the land here adjacent to the sea is hilly and mountainous, in which respect it is distinguished from the generality of the coast of Guiana, that is for the most part low, and covered with swamp-pines, a species of large trees which grow even in the sea, and form forests at a considerable distance from the shore. The central parts are low and swampy, subject to continual inundations; the necessary means for the prevention of which, it is much doubted whether the soil be good enough to justify putting in practice. All the productions of the neighbouring continent are supplied also by the island; but with this difference, that the latter is as it were exhausted, and does not equally indemnify the planter for his trouble and expence. The number of the inhabitants, exclusively of the garrison, amounts to about 1000 or 1200 whites, persons commonly of the lowest class, who are chained down as it were to the glebe of the colony, because their means will not allow them to emigrate to other parts. They cultivate merely as much land as is requisite for their subsistence, obtaining from Europe in return for the part of their scanty produce which they can spare, wine, flour, clothing, and some other things of which chiefly they stand in need. The remoter continental lands are often fruitful in a very astonishing degree; yet as the produce of the soil, which is a kind of black sand, covering a loamy clay, and fit for making bricks, is not to be obtained without labour and expence, the culture of it has been much neglected. Several of the settlers, thinly scattered over vast deserts, and separated by impervious brakes and brambles, and, at the same time, surrounded by negroes, who threatened to endanger their safety and peace, have relinquished cultivation altogether, confining themselves to the rearing of cattle, which could be kept without care or trouble, in the immense savannas or natural meadows of the country. In these interior parts, little as the improvement of them has been attended to, and though, consequently, they remain obstructed by thick forests and underwood, and almost in all respects quite in a state of nature, there is fed a great number of horses, sheep, goats, and cattle, which roam in them at pleasure; and the beef and mutton obtained in this mode of rearing and pasturing the animals are reckoned excellent.

The climate of Cayenne is much more salubrious than that of any of the Antilles. There are here properly only two different seasons, the dry and the rainy seasons. The former generally continues from the beginning of June until the end of September, during which time the heat is commonly very oppressive, the air is almost always serene, and scarcely a few drops of rain descend to purify and cool the atmosphere. The heavy falls of rain begin in the month of October, and are very frequent in December, January, February, and March, at which time they begin gradually to decrease, until the dry season again sets in. During the rainy season, that is for 7 or 8 months, the heat is very moderate for a place so near to the equator. Nay, the negroes sometimes complain of cold; and, upon the whole, the state of health is as good there as in Europe. However, at the time when stagnant waters are dried up and corrupted by the heat, fevers prevail for about two months, which, though not contagious, prove very destructive.

This town, the capital not only of the island of the same name but of the colony at large, the seat of government, and of the courts of justice and of the military, is situated close to the sea on the right bank, and near to the mouth of a river also of the same name, which is there about a league in width. It is of small dimensions, the houses are badly constructed of wood, and it is surrounded by a swampy moat and wretched walls, which form a sort of irregular hexagon. The fort that commands the town is built of earth, and is tolerably strong towards the sea, especially for this reason, that, from the want of depth of water, ships of a large size cannot approach it within gun-shot. The navigation moreover on this coast is generally dangerous, being impeded by banks of sand and mud-flats of considerable extent, which frequently shift. There is besides not even any harbour of consequence in these parts, except that which the island affords, nor scarcely a place indeed where a boat may land with safety, particularly during the prevalence of the heavy rollers and breakers in the times of the spring tides. The palace of the government, and the ancient mansion of the Jesuits, are the only buildings in this city deserving of particular notice. They form two large façades fronting the place of parade, which presents a pleasing prospect, being bordered with two rows of orange trees of the largest size, that exhale an exquisite fragrance, and are crowded with colibris skipping from branch to branch. The population of this town having of late years increased, and its circuit not admitting of a proportionate enlargement, a new town has been built on the neighbouring savanna, separated from the ancient one merely by a ditch. This, which is already the more considerable of the two, and is daily increasing, is constructed on a regular plan; the streets are wide, admitting the free access and circulation of air, and contains some elegant houses, the beautiful appearance of which becomes more striking, from the obvious marks of poverty and wretchedness exhibited by every thing about them.

The inhabitants of French Guiana have within their reach an abundant supply of all the requisites for a good table, but they generally prefer salt meat and fish to fresh provisions. From their relish also for high-seasoned foods, they cultivate for culinary purposes, besides the pepper called by the name of the province, several other sorts, the sharpest and most pungent they can procure. The Creoles prefer the cassava, which is a large round cake, about three lines thick, made of coarse flour of manioc, and slightly baked on a tin-plate, to the best and finest sorts of bread. Besides the other articles of subsistence common to Guiana and other colonies, there is in frequent use here a dish called *calatoll*, which is prepared of the fruit of a plant known by the name of *combua*. At every meal a negro, when the first course is removed, presents the guests with a glass of ratifia. This liquor is as transparent at Cayenne as the purest spring-water: it is very wholesome, and acquires a more pleasant flavour the older it grows, especially since the practice has been introduced of distilling it over newly gathered cinnamon. The same liquor, which is prepared here, and indeed forms a considerable article of the commerce of the province, is in great request on the tables of the luxurious at Paramaribo, and throughout these colonies.

The dress of the male sex in Cayenne consists in white pantaloons and a linen jacket. The women spend most of their time in hammocks, a piece of furniture which is much valued in Guiana, and which serves at once for ornament and convenience. These hammocks are made of cotton. They are in general from six to seven feet in length and nearly of the same breadth, and are fastened on both ends by a number of small cotton strings, which join to large ropes of the same stuff. By these ropes, which are attached to the walls of the room with large hooks, the whole burden of the hammocks is supported. It is in the corners of the room commonly that these hammocks are thus suspended, where they hang like swings, and in a garland-like form. Very fine specimens of such hammocks are made at Cayenne, but the most beautiful are imported from Peru in Brasil on the right bank of the river Amazon. Those latter hammocks are made of variegated cotton after various designs, and ornamented with borders, tassels, and fringes. They cost about 50 dollars. See Bolingbroke's *Voyage to the Demerary, &c.* (K)

CEANOTHUS, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 146.

CECIL, William, Lord Burleigh, the famous minister of Queen Elizabeth, was born at Bourn in Lincolnshire, in 1520, of an ancient and respectable family, his father, Richard Cecil, being master of the robes to Henry VIII. After receiving the rudiments of education at the schools of Grantham and Stamford, he was sent, in his fifteenth year, to St John's college, Cambridge, where he distinguished himself by the regularity of his habits, and unwearied assiduity. It is recorded, that he made an agreement with the bell ringer, to be called every morning so early as four o'clock. Logic and Greek were his chief, but not his only studies, for he soon discovered a wish to take in a comprehensive range of information. In 1541 he was removed to Gray's Inn to study law, where he displayed the same indefatigable application, making it a rule to commit to writing every thing worth notice in the course of his reading, and taking the pains to arrange his information in the clearest order. Many of his manuscripts are still preserved, in private and public libraries. The intimacy of his father at court, having procured his introduction at an early age to Henry, who piqued himself both on his learning and his discernment of learned men, Cecil was soon induced to prefer a political to a legal career. In this determination he was confirmed by matrimonial connections, the friends of his first wife, whom he married when he was only twenty-one, having introduced him to the protector Somerset. This introduction was afterwards strengthened by the king's preceptor, Sir Anthony Cook, whose daughter Cecil married some time after he had the misfortune of being deprived of his first wife. Zealous like Somerset in promoting the Reformation, Cecil received from that nobleman the respectable appointment of master of the requests, and continued to discover so much assiduity and ability, as to be thought worthy of the station of secretary of state, at the early age of twenty-eight. The protector being soon after overpowered by the intrigues of the Earl of Warwick and his party, Cecil fled with his patron; but, after a confinement of three months in the Tower, the joint effect of the young king's favour, and of his own aptitude for business, was his re-instatement in his office of secretary under the new leaders. On this occasion he was knighted, and when he entered on office, he afforded, amid all the cabals of the time, the example of a minister occupying himself exclusively with the concerns of his department. By these means he avoided all concern in the intrigues by which Warwick, now duke of Northumberland, sought to secure his own ascendency for life, by getting the succession to the crown vested in Lady Jane Grey. Cecil performed his duty in co-operating to place the crown on the head of the lawful heiress, Mary; but aware at the same time of her bigotted attachment to popery, he made no other use of his influence than to obtain a pardon for any thing that might have offended her in his past transactions. The new court would gladly have had the benefit of his abilities in office, but an abjuration of the Protestant religion was, with Cecil, an inadmissible condition, and he retired for a time from all interference with politics. He was soon, however, returned to parliament for Lincolnshire, and though this took place without his solicitation, he acted his part in the House with great firmness, and incurred some danger by advocating the popular cause. That danger would have been increased, had it been discovered that he was in the habit of corresponding with Elizabeth before the death of her suspicious sister.

On Elizabeth's accession, (1558,) Cecil was the first privy counsellor sworn in, and in the capacity of Secretary of State, entered on that career of public service, which was destined to last during the long period of forty years, and to terminate only with his life. He lost no time in directing his sovereign's attention to the establishment of the Protestant religion, according to the present form of worship of the church of England. In advocating the cause of simplicity in the reformed ritual, he experienced considerable difficulty from Elizabeth's predilection, (though a Protestant,) to the imposing splendour of Romish ceremonies, a predilection in which the queen received the support of many dignitaries of the church. In civil affairs, the ascendency of Cecil was far more conspicuous. His thoughtful habits, and a facility in composition early acquired, led him to follow the rule of recording on paper his opinions on subjects of importance, and writing answers to all publications hostile to the queen's government. That economy of the public money, which is in the mouth of every minister, was perhaps never so judiciously and effectually practised as by him. The rule of this reign was not to withdraw from the burden of continental wars, but to avoid taking a leading part, and to confine the exercise of interference to those circumstances in which it had become indispensably necessary. Teaching her allies to rely on their own resources, Elizabeth was accustomed to bring home her troops, and redemand her loans as soon as the state of military operations permitted it. Her cautious minister persuaded her to despise all dreams of continental acquisition, and to decline even the proffered sovereignty of Holland. Cecil was, in consequence, often censured as the adviser of a narrow-minded policy, but he was indifferent to such accusations, and placed his reliance on the evidence of facts. He resisted also, as much as in his power, the importunities of idle and rapacious courtiers. While thus hostile to irregular grants, he was punctual and even liberal in the reward of real services. He is considered the author of a very material reform in the mode of paying the army, by which the money of the soldiers, instead of going through the medium of the officers, a practice liable to great abuse, was transmitted directly from government to the privates. From this, and other circumstances, arose the saying, that "the queen paid liberally, though she rewarded sparingly."

The gradation of Cecil's honour was as follows: In 1561 he was promoted to the office of master of the wards, or, in other words, president of the court of wards. In 1571, after he had been the chief instrument of extinguishing a dangerous rebellion in the north, he was made Baron Burleigh; and in 1572, after escaping from a conspiracy against his life, in which the Spanish ambassador was implicated, he was made a knight of the garter. In the same year, on the death of the lord high treasurer, he was raised to that exalted and laborious station. In the exercise of its functions, Cecil was equally vigilant in regard to the collection and distribution of the public money; permitting no undue partiality in the former, and, in the latter, making it an express rule to issue nothing without a direct order from the queen. He never imitated the usual practice of treasurers, in occasionally borrowing from the treasury for private purposes; and he was almost the only minister of that age, who, at his death, owed nothing to the public. Though frequently the admirer of vigorous measures, the general character of his policy was pacific. "War," he used to say, "is soon kindled, but peace is very hardly procured." "A realm gains more by one year's peace than by ten years war." The reader who will take the pains to compare the ambition of Europe in these days and in our own, will find, that, while the inducements to war were equally great, the course of policy pursued in the two cases, forms a remarkable contrast. Scotland and France were at that time torn by intestine convulsions, and the low countries involved in a tedious war with Philip II. All presented tempting opportunities of conquest to an English army; but conquest, Cecil well knew, is not the true foundation of national strength. He was the first to discover the hostile intentions of Philip towards England, but delayed, as long as possible, the resort to actual warfare. When the defeat of the armada put a finish to Philip's hopes, and disposed him to reasonable terms of peace, Cecil, who had hitherto been most vigilant in opposing him, now became the advocate of a cessation of military operations, unsuccessfully indeed, for the passions which prompted a continuance of the war were too violent to yield to reason and argument. Zeal for religion, revenge for meditated subjugation, and the hope of rich captures, all contributed to stimulate the nation to a prosecution of hostility against Philip. In regard to France, the public mind being less strongly agitated, Cecil's prudent counsels were adopted by his sovereign, and, agreeably to them, such assistance only afforded as was requisite to preserve the Hugonots from falling under subjection to their Catholic adversaries. Succour to that extent was called for by the cause of religion, but to go farther would, in Cecil's opinion, have answered no useful purpose, since he was satisfied that the French government, whether Protestant or Catholic, would remain equally the rival of England. He persevered accordingly in the same cautious course, after the massacre of St Bartholomew had kindled the spirit of the nation to such a height as to make our nobles and gentry come forward and volunteer a crusade against the Catholics of France at the head of 30,000 men.

The policy of Elizabeth, in regard to Scotland, was more delicate and complicated than towards either France or Spain. Mary had committed the imprudence, never to be forgiven, of assuming her title, and disputing her legitimacy. She eclipsed Elizabeth, likewise, in those personal charms, of which the queen of England was as jealous as the less enlightened part of her sex. On the other hand, the free tenets of the Scottish Protestants were as much the aversion of Elizabeth as those of her own Puritans. When they proceeded to bring their sovereign to trial, and to deprive her of her liberty and her power, the high prerogative feelings of Elizabeth were alarmed, and she could with difficulty be restrained from sending an army against them. The long confinement to which Mary was afterwards subjected in England, resulted from the concurrent advice of Cecil and of all Elizabeth's ministers, who regarded her as an implacable enemy, both to their mistress and their religion. They represented, likewise, that the possession of the person of the Scottish sovereign gave Elizabeth a powerful hold over the Protestants in Scotland, who dreaded nothing so much as the return of an offended sovereign. In the trial of the unfortunate Mary, Cecil was one of the leading commissioners. He was privy, also, to the transmission of the warrant for her execution, though by no means the principal cause of that unjustifiable act, as his artful sovereign affected to declare. No princess ever understood better than Elizabeth the art of shifting odium from herself; the blame of the Duke of Norfolk's death having, in like manner, been charged by her on Cecil.

To perform the various duties of the situations occupied by this statesman, required an extraordinary share of application. Yet, by adhering strictly to method, and to his favourite maxim, that the "shortest way to do many things is to do one thing at once," he contrived to fulfil his task without either hurry or confusion. In his court, he expedited more causes in one term than his predecessors had been accustomed to get through in a twelvemonth. Even when labouring under severe pain from gout, he frequently made himself be carried to his office for the dispatch of business; and one of his contemporaries has declared, that, during a period of twenty-four years, he never saw him idle for half an hour together. He was remarked for preserving an unaltered countenance in the most embarrassing situations, and for allowing no one among his friends to acquire an ascendency over him, so as to influence his public conduct. He behaved with great command of temper towards his enemies; and as he favoured his familiar acquaintances no more than strangers, in regard to government promotions, it became a common saying, that he was a "better enemy than friend." Merit in their respective departments was with him the only title to preferment; and never were the agents of the English government better chosen than under his direction. He was remarkable for obtaining early intelligence of the secret plans of the queen's enemies, both at home and abroad; and if the methods to which he resorted for this purpose were exceptionable, we should recollect, that he lived in an age when the public doctrine of his antagonists was, to "keep no faith with heretics." No man could be more delicate or impartial in the administration of justice,—a virtue by no means common in those days, when the favour of the great was the road to wealth and preferment. It was common for him to receive every day, during term time, a number of petitions, which he took home with him, read during the evening, and was ready with his answers to the whole body of applicants the next morning.

His stile of living was more costly than might have been expected in a man so completely absorbed in business. He had four places of residence,—his lodgings at court, his house in the Strand, his seat at Theobald's, which was his favourite resort, and Burleigh-house, the family residence. It was computed, that his domestic expences at his house in London amounted to 30*l.* a week in his absence, and 40*l.* or 50*l.* when he was present. This stile of expence, and the open hospitality connected with it, have been ascribed to the view of cultivating popularity. It was at Theobald's that he was accustomed to receive his share of those frequent visits with which his royal mistress was accustomed to compliment her principal ministers. In regard to the queen's temper, though his gravity and respectability of character exempted him from frequent returns of those sallies of passion which she was accustomed to vent on her courtiers, he was subjected, notwithstanding, to serious mortification. At several periods of his long career, we find him desirous of retiring from office; but Elizabeth would never listen to it, and used to rally him on it in letters which are still preserved, and form a curious contrast to the stately gravity of official communications in the present day. While she would not hesitate, when contradicted, to call him a "froward old fool," she was studious, at other times, to make up, by a return of attention, for such occasional rudeness. When, in his latter years, his gout had become very troublesome, she used to make him sit down in her presence, saying, "My lord, we make use of you, not for your bad legs, but for your good head." The attacks of this complaint concurred, with his habit of business, in rendering him very temperate. His rule was, to partake of few dishes, to drink *only* thrice at a meal, and very seldom of wine. Though noon was, in these days, the hour of dinner, it was not unusual with him to refrain from supper.

Burleigh was remarked for his piety, and, in regard to his tenets, was strictly attached to the established church. He was regarded, in fact, as its official protector at court; a circumstance which is thought to have induced his rival Leicester to place himself at the head of the Puritans. In addition to his other good qualities, he was eminently charitable, it being computed that he and Lady Burleigh distributed annually 500*l.* to the poor. His death took place in 1598, in his 78th year. In summing up the leading features of his character, we find no pretensions to the possession of oratory, or of engaging address; unwearied application and cool consideration constitute the basis of his fame. Neither his speeches nor writings indicate any attempt to display imagination,—all appears the rigid and deliberate exercise of intellect. It is needless to say, how much more of the statesman is discovered by these qualities, than by that which so often constitutes a passport to power,—a fluency in public speaking. And when we look back to the judgment with which Burleigh steered the vessel of the state, in times no less perilous than the present, we may be induced to wish that the habits of our ministers were more akin to those of this cautious and successful statesman; in particular, that it were in their power to retrench the share of their time appropriated to parliamentary debate. A larger proportion would thus be left for the exercise of that reflection in the closet, which so eminently characterised the cabinet of Queen Elizabeth, and was the source of that renown with which his name has been handed down to posterity. (*x*)

CECIL, Robert, Earl of Salisbury, son of the preceding, though less eminent than his father, was sufficiently distinguished to merit a place in British biography. He appears, for the date is by no means free of doubt, to have been born in 1563; and, after serving in the English fleet against the armada, and being returned member for Hertfordshire, he was appointed, in 1596, second secretary of state under Sir Francis Walsingham. Having the advantage of his father's admirable example and instruction, he was thought worthy to succeed him in the high station of lord treasurer, and continued to fill it during the remaining years of Elizabeth's life. Though frequently at variance with the Earl of Essex, he did not yield to that impetuous nobleman in rooted antipathy to the Spaniards. Attached as he was to the queen, and zealous in pleading in parliament in defence of her obnoxious measures, he was too knowing a courtier to neglect the rising sun, and ventured on a correspondence with King James, which had at one time been well nigh discovered by his suspicious mistress. Being still a commoner, (for he was a younger son of Lord Burleigh,) King James, on his accession, bestowed on him the honour of a peerage, and soon after made him one of the knights of the garter. Though not continued in the post of treasurer, he was confidentially employed, and was almost the only minister who resisted the growing influence of the Spaniards at court. On the death of the Earl of Dorset in 1608, he was appointed to succeed him as treasurer,—a place of great difficulty, in consequence of the king's thoughtless profusion. To this unfortunate disposition he made so much opposition as prudence allowed, and was, on the other hand, indefatigable in drawing the utmost from the royal demesnes. At the same time, he was by no means unmindful of his own interest, and, though he surrendered the patent for the mastership of the court of wards, he found means to amass a very considerable fortune. He approved himself in parliament an equally zealous advocate for the prerogative under James as under Elizabeth. His constitution, always delicate, was impaired by application to business, and began to give way in 1609. The decay was progressive till 1612, in which year his death took place.

Compared with his father, the Earl of Salisbury will be found a minister of perhaps equal ability, but inferior in candour and probity. His particular talent was in diplomacy, for no man could more dexterously penetrate, in a conference, the views of foreign ministers, or conceal his own. Notwithstanding his love of money, he was completely above the reach of corruption from abroad. His exceptionable acts in raising public supplies, by the sales of titles, and otherwise, are to be attributed chiefly to the factious and corrupt character of the court. The great imputations on his memory, are his hostile measures against two eminent but unfortunate men, the Earl of Essex and Sir Walter Raleigh. In regard to the former, it is pretty clear, that the part he acted was dictated by his duty to his sovereign and his country; and as to the latter, it is possible, that when, by the publication of farther documents, we become fully acquainted with the history of the transaction, we shall find reason to acquit him of vindictive persecution. Those who dislike his memory, in consequence of his subserviency to the crown, may have some satisfaction in learning, that his life at court was by no means a happy one. In 1603, after James's accession, he wrote to his friend, Sir John Harrington: "Good knight, I am pushed from the throne of comfort, and know not where the winds and waves of a court will bear me. 'Tis a great task to prove one's honesty, and yet not spoil one's fortune. I wish I waited now in your presence-chamber, with ease at my food, and rest in my bed." And, in his last illness, he addressed to his friend, Sir Walter Cope, the following remarkable expression: "Ease and pleasure quake to hear of death; but my life, full of cares and miseries, desireth to be dissolved."

In his person the Earl of Salisbury was little indebted to nature, being very crooked; but his countenance was not unbecoming; and he was remarked for the fierceness of his eye. He was allowed by his enemies to be an excellent speaker, though an indifferent writer. Several of his speeches were printed, as well as a book against the Papists, and *Notes on a Discourse* (by Dr John Dee) *on the Reformation of the Calendar*. His official letters to our foreign ambassadors are very full and explicit. Many of them are to be found in Sawyer's *Memorials of State*, a work of 3 vols. folio, published in 1725. (χ)

CECROPIA, a genus of plants of the class Diœcia, and order Diandria. See BOTANY, p. 127.

CECROPS. See ATHENS, Vol. III. p. 12.

CEDRELA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 147.

CEDROTA, a genus of plants of the class Octandria, and order Monogynia. See BOTANY, p. 198.

CELANO, the name of a town and lake of Naples, in the province of Abruzzo Ultra. It is about 47 miles in circumference, 10 miles wide at its greatest breadth, four at its least breadth, and its average depth 12 feet. This lake is embosomed in an amphitheatre of lofty mountains crowned with snow, and its margin is covered with numerous villages, and well cultivated farms. The ground is well inclosed, and the sides of the mountains are covered with thriving woods. The lake abounds with a variety of fish, and wild fowl in great quantities repair to it at stated seasons. The emissary of Claudian, for draining the lake, is about a mile and a half from the town. It is a tunnel, three miles long, in some parts cut through the solid rock, and in others supported by masonry, with openings from above to admit light and air. In many places it is choked with rubbish and earth, and is of no use in discharging the superfluous waters, which escape with difficulty by some unknown channels. As the lake is supplied by three considerable streams, it is often raised above its ordinary level. See Sir W. Hamilton's paper in the *Phil. Trans.* vol. lxxxvi. p. 368; and Swinburne's *Travels*. (*j*)

CELASTRUS, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 146.

CELEBES, a large and populous island in the Indian seas. Neither the exact site nor dimensions of this island are known to be yet ascertained. Captain Forrest, a judicious navigator, affirms that it stretches from about 2° north latitude to 6° 10′ south, and lies between 116° 40′ and 121° 40′ east longitude. Von Wurmb lays it down from the third degree of north to the fifth degree of south latitude, and fixes its longitude under 136°. Some navigators and geographers maintain, that its breadth is 500 miles, others restrict it to 70, or even 45. Probably it does not exceed 100 in the broadest parts, and diminishes considerably in the narrowest. We may remark, in general, that though valuable European settlements have long been established here, there is scarcely any island in the same situation, in the history and description of which greater confusion prevails.

By the natives, and also the neighbouring people, this island is called, *Negree Oran Buggess*, or *Tanna Macassar*. Though lying directly under the line, the climate of Celebes is temperate, from the heat being moderated by the sea breeze circulating among the mountains and vallies. Slight shocks of earthquakes are sometimes felt, and violent storms occasionally visit the country.

Gold is obtained in several districts of Celebes, particularly towards the east, from the beds of rivers or torrents issuing from the mountains, and also from pits purposely dug for it. On discovering a gold mine, the workmen first conduct water to its immediate vicinity, and then dig down until finding a kind of black sand among which it is lodged. Quantities of this are taken up by the miners, who place themselves amidst a pond, pool, or stream of water, and putting the sand into a flat wooden dish, wash the whole gradually away, until the heavy particles of gold falling to the bottom, alone remain in a cavity in the centre. The gold thus collected is dried in a cocoa nut shell near the fire, and cleansed as well as possible from any remaining grains of sand. Before digging a mine, the workmen turn aside the nearest river, or drain off part of it; then they search a foot deep in the sand for pieces of native gold. Their expectations of success are regulated by the appearance of the neighbouring stones and rocks: Where rich ore is found, blue and yellow are predominant; where the ore is of less value, the stones are grey. Gold is obtained from the crevices of the rocks in pieces of considerable size; one was lately seen weighing nine pennyweights, and others are got equal to two or three rials. The water, issuing from the mountains, brings down earth along with it, which being received in vessels, deposits the gold in the bottom after the water has filtered through. For the most part, the gold of Celebes is pure and of the richest quality, but generally more valuable at the first opening of a mine. No accurate calculation can be formed of the quantities obtained throughout the island, but the Dutch were formerly enabled to procure to the value of 124,000 *l.* annually. Iron and copper are likewise found in considerable abundance.

The hills of Celebes are covered with woods, among which are fruit trees and bushes known only by description to Europeans. Lemons and oranges are in great profusion; and also the more necessary plants of sugar cane, Indian corn, rice, and cotton.

Of quadrupeds, there are horses, cows, buffaloes, wild hogs, goats, and sheep of large size. The horses are of a small black breed, and are greatly esteemed by the natives. The flesh of cows and goats is ate, but no use whatever is made of the milk.

This island is plentifully stocked with wild fowl and poultry, and a great quantity of turtle abounds on the coast. The latter is a principal object of pursuit among the natives, not as an article of food, but for the sake of the shell. This they are said to possess the singular art of taking off without injury to the animal, which, after the operation, is allowed to escape.

The inhabitants of Celebes are supposed to be two or three millions in number. Yet, though it be certain that the island is extremely fertile and populous, we conceive that the calculation is exaggerated. They are of a copper colour, or reddish yellow, rather of a squat figure, and ungraceful demeanour. Nevertheless some of the women have regular features and pleasing countenances, and are nearly as fair as Europeans. In general, the natives are suspicious, cruel, and ferocious, the common character of mankind in the same latitudes; but they are ingenious, high-spirited, and brave. The men are capable of great fatigue, and can patiently endure protracted abstinence; they are temperate in living, and hence longevity is frequently met with. The women are greatly addicted to sensuality, susceptible of warm attachments, and their jealousy is unbounded.

The heat of the climate is so favourable to vegetation, that agricultural operations are attended with little care or anxiety. Rice, cotton, and the sugar cane, are its chief objects. The fields for cultivating the first of these vegetables are divided by fences, which shews that the natives have an accurate notion of the distinction of property, and the disposition of the surface is accommodated to essential circumstances. Some of the grounds for producing rice are on declivities, where little canals about twenty yards asunder are formed for the irrigation of the land. The fields are overflowed to the depth of six or eight inches during sixteen days, and being then in a very humid state, about 20 bullocks trained to the work are inclosed, and driven round and round until the ground is completely poached. Water is again admitted to overflow the surface, and the land is afterwards considered in a fit state to produce the crop. Rice plants are next stuck into the mud eight inches asunder, and, until half grown, the ground is constantly watered; but at that period the shade of the plants keeps it moist, which obviates the necessity of continuing to overflow it. Being cut and put up in small bunches when ripe, the rice is built into stacks, and after remaining thus about fourteen days is carried home. To preserve it from the weevil, it is not cleaned from the stalk, and, by occasional airing, it may be kept fit for use during two years. With similar precautions, Indian corn may be preserved six months. Abundance of sago is obtained, and may be called a substitute for bread among the numerous inhabitants of Celebes. It is a preparation from the soft pith of a tree, which is described as resembling the cocoa tree, but with a larger leaf, and about two feet in diameter. Being felled, the trunk is divided into pieces of about ten feet long, which are split up by means of wedges. The pith is taken out, pounded with a mallet, and washed in a river, after which the sago is separated from the bran, and carried home in utensils made of leaves. It is dressed or baked without water; if put aside in a pot, the sago soon becomes moist and forms into a cake, in which state it will keep several days; if not required for immediate consumption, it is laid in a stream, where it may be preserved six or eight months. The sugar cane is cut into joints, from which the outer skin is peeled, and the joints pounded to softness in large mortars. In the next place the substance is pressed, and the liquor boiled until it attains a certain consistence, when it is taken off the fire and cooked. This is kept for making sweetmeats, the only use to which it is applied.

Thus the natives of Celebes appear imperfectly skilled in agriculture; but profiting by the soil and climate, they obtain abundant crops, part of which are exported.

Great confusion prevails in any accounts that can be procured of the civil divisions of territory in this island. It is evident, however, that they are numerous, and that the inhabitants of each have a certain peculiarity of manners which distinguishes them from those of the rest. Six or seven principal divisions have been named, which seem independent of each other. Goa or Goach, Bony or Pony, Wajoo or Tuadjoo, Sopin, Selindrim, and Mandhai. Besides these, are Tello, Sandrabony, and various territories, which may partly be synonymous with the former. Dispersed throughout these divisions are different tribes, called by some Barreo, Tobogees, Tremany, and Uncuila, who inhabit towns and villages chiefly towards the coast. The British are best acquainted with the town of Macassar, from a Dutch settlement being established there. It was lately calculated to have contained about 10,000 native inhabitants, of whom 2000 were capable of bearing arms. Two towns, Parlow and Dungally, are situated in Parlow Bay. The former is of considerable size, consisting of about 500 houses, and is the capital of a fertile district called Kyly, or Uncuila. It is a place of considerable trade, and the residence of many wealthy native merchants. The latter is towards twelve miles distant, and independent of its government. It stands on a point of land, and is defended by a fort or block-house situated on a hill, in which are about 15 swivels, 30 blunderbusses, and 200 small arms. Considerable trade is carried on from both these towns, and numerous artificers inhabit both. The town of Tomboo stands at a little distance from the sea, on the banks of a river flowing into a fine bay of the same name. It is less compact than the others, and contains about 700 inhabitants, who have only a few small arms for their defence. They are a warlike race, but seem possessed of very little prudence; for though abundantly stored with provisions, they dispose of them so regardlessly, that they are not only often obliged to purchase a supply from other places, but sometimes reduced to want. Besides these towns, there are many more along the western coast, and towards the south parts of the island, which have been more frequented by Europeans than the others.

With respect to the trade and manufactures of the natives of Celebes, as their wants are few, their commerce is limited; neither do they carry on any regular trade with more distant countries, especially from having scarcely any manufactures that would be an object of acquisition, though valuable to themselves. However, they weave a quantity of very fine cotton cloth, chequered red and blue, which is greatly esteemed in India, and is imitated on the coast of Coromandel. They also weave strong white cotton cloths, from the abundance of cotton on their island, which they are very expert at cleaning. Beautiful silk belts, wherein they fix their creeses or daggers, likewise are manufactured; and they make a kind of paper from the inner bark of a small tree. They understand the art of working in gold and silver; and can cast brass guns six feet long, which will carry a half pound ball. A number of slaves are annually sold to traders from Batavia or elsewhere. These unfortunate beings are generally kidnapped, and being secretly sold to Europeans, are carried away in their vessels. A Chinese junk or vessel of large size annually arrives at Macassar, and the goods being exposed to sale in a large building specially adapted for the purpose, are very soon disposed of among the natives, the Dutch, and other settlers. Arms and ammunition, iron and steel, blue and white cloths, and opium, are imported. Gold, rice, sago, tortoise shell, and cotton cloths, are, besides the articles already named, among the exports.

Several remarkable peculiarities are seen in the government of the petty states of Celebes: each is ruled by a rajah or chief, some of whom succeed by inheritance, and others are elected to the dignity. The female sex is not excluded from the highest degrees of sovereignty. Something resembling parts of the feudal system, as recognised in Europe, is also seen in the island. Formerly the rajah, or king of Goach, as he is denominated by the Dutch, was the most powerful in Celebes, although the territory of Bony it is said could send 70,000 fighting men into the field. But the policy of that nation having been to maintain one tribe against another, his power has declined. Bony is governed by a rajah called *Pajong*, who is elected by seven chiefs, enjoying this privilege by hereditary right, and which may rest in women by descent. The Pajong is under controul of 400 representatives of the people, of three different degrees, who have a voice in the government of the country. Wajoo or Tuadjoo is governed by a rajah, elected from the chiefs of the highest rank, who are chosen from forty others of lower rank, but who nevertheless are said to be the actual rulers of the state. Besides these there is still another order, who, as before, have some controul in state affairs. The council of forty, of which women may be members equally as men, determine questions of peace or war. They are divided into three portions, each of which has a chief banner or flag. Two chiefs are elected from each of these divisions, one of whom has the administration of civil, and the other of military matters, and over the whole is the fortieth person, called *mattoua*, or *aramatooa*, the sovereign of the whole. Thus there are two from each division, and the sovereign or rajah. When the *aramatooa* dies, the thirty-nine survivors elect one of themselves to the dignity.

An oath of fealty, somewhat similar to that which of old was known in countries acknowledging the feudal system, and also investitures of land, prevail in Celebes. At least we know, that such is the case with regard to foreigners. The person is introduced to the presence of the rajah, when he takes up a shield and dagger, and goes through all the warlike manœuvres of the people with great violence and agitation, at the same time vowing vengeance against the various tribes at war with the rajah. This being done, the dagger and shield are laid down, and if the person be a man of consideration he seats himself by the rajah, while the others to be sworn in, perform a similar ceremony. When one obtains a grant of land he takes possession of it in form, by kindling a fire upon it, and piling up a heap of stones, a ceremony resembling the sasine used in this kingdom.

It is said that some of the laws of the natives of Celebes are written, and that others are administered according to the custom of their predecessors, as preserved in the remembrance of aged persons. Crimes are not punished arbitrarily at the will of the chief, but according to established laws. The accusation, however, is brought before him, and he orders an investigation of the fact. When a report is made, if it be of a crime deserving capital punishment, the chief gives a sign with his eyes, and the culprit is carried forth and poniarded. Should aggravated circumstances have attended it, the chief ordains a more severe punishment: the criminal is bound to a tree, and his skin pricked with daggers in innumerable places, which are rubbed over with sugar and molasses. His whole body is soon covered by swarms of ants, and he is literally devoured alive. This horrible punishment is never inflicted on persons of high rank, who are simply poniarded to death. Nevertheless some of the rajahs rule with arbitrary sway, and little account is made of life by the natives.

The different tribes are frequently involved in mutual wars, originating from very slight occasions, and they even venture attacks on Europeans, which are generally irregular. All are noted pirates, and commit many depredations on the vessels of every nation which they meet at sea. There they are held in greater dread than by land; their vessels being often mistaken for those of more pacific people, and because much stratagem is employed to decoy the unwary. Long voyages are made by them to Prince of Wales Island, Batavia, and so far as the coast of New Holland. In engagements by land the victors decapitate the slain, and prisoners are sold for slaves at between 5*l*. and 10*l*. each. The arms are, spear, dagger, and shield; but many have muskets likewise. In the words of an intelligent voyager, one of these natives "altogether very much resembles a Scotish highlander when the ends of his plaid are sewed together. His arms are a sword, lance, dagger, and target; sometimes a musket and bayonet or blunderbuss instead of the lance; but then he is attended by a lad, who, himself armed, carries several lances." In particular districts the natives fight with barbed arrows poisoned, blown out of black ebony blow guns about four or five feet long. In the use of them they are very expert, and can kill at the distance of twenty yards. The effect of these arrows is most destructive, and the object speedily expires in excruciating agonies.

The Mahometan religion was established in Celebes in the end of the sixteenth or beginning of the seventeenth century, and the inhabitants thence entertain a great abhorrence against Christians. There is a high priest, who in one district was, of late years, a foreigner from a distant island, to whom much deference was shown. A rajah desirous of making war, previously consults the priest on its probable success, who, after a pretended reference to a book, declares his opinion: if unfavourable, the rajah prefers submitting to an indignity: if the reverse, he prepares for it by providing himself with a charm from the priest, which he believes renders him invulnerable. But the charm, which is only a square piece of paper inscribed with certain characters, remains no more than six months in force.

The inhabitants of Celebes do not adhere strictly to the Mahometan law in their matrimonial alliances. If a man can afford to maintain four wives, he may marry that number, but not otherwise. The marriages of the higher ranks are attended with many ceremonies, and are always preceded by presents. Three swivels and twenty pieces of white cloth are considered a liberal donation when, on a recent occasion, the children of two chiefs were united. Here the man had accidentally visited Celebes in a piratical vessel from another island; and on the day appointed, his father, the commander, together with his crew, came on shore, armed as if for battle. The high-priest then attired him in a pair of long silk trowsers, and also in five or six silk gowns of different colours, with a wrapper over the whole: he put a cap on his head, which was surmounted by a turban. A procession towards the town, which was the residence of the woman's father, ensued: the bridegroom being guarded by twenty of his own men armed with spears and shields, on whose approach a number of men armed in the same manner issued from the town, when a sham fight well supported began. The townsmen, however, gradually retreated until they reached the gate, when a piece of chintz stretched across prevented their entrance. It was withdrawn on the defender's receiving a present of a little beetle-nut, but replaced elsewhere, while the sham fight continued with múch apparent vehemence, until the donation was repeated. This ceremony was successively renewed, the townsmen always retreating until the man reached the house of the bride's residence. Immediately upon his entrance, he seated himself beside her, and the high-priest performed the marriage ceremony, enjoining mutual regard, and telling the bride she must forsake all other men for her husband's sake, be attentive to him and acknowledge his superiority. The priest then began to sing a lively tune, at the close of which all the guests joined in chorus.

Youths are circumcised at about the age of fifteen, and a year after undergo the ceremony of having their teeth blackened, which last operation is performed on girls also, and is considered an ornament. Different festivals are celebrated on the island, which vary according to the period, and the parties that participate in them. One is held at the close of harvest, when a large tree full of branches, but stripped of the leaves, is brought into the middle of the town, and stuck in the ground. The ends of the branches being cut off, are replaced by the extremities of sago or cocoa-nut branches, so disposed that the leaves hang down, and baskets containing boiled rice or Indian corn are suspended from them. When the tree is thus completely decorated, every person in the town contributes a dish of something, such as fish or fowl, for a feast at sun-set, and collect to dance about it. An exterior circle is formed by the old people, an interior one by the war-men and their wives, and within that is another of youths and girls. Dancing is protracted until midnight, when they partake of the feast, beside a large fire, and by the light of lamps. The dance is then resumed; and the tree afterwards, with great tumult, in which all engage, is despoiled of the baskets of rice. This done, the actors again return to the feast, which is now finished.

The principal diversion of the people is cock-fighting, which is practised every afternoon, and is very well understood among them. The whole men in a town collect to participate of the sport, and spend half the night in gambling with cards and dice when it is over.

The natives of Celebes entertain an idea, that if a sick person can eat he will recover; and employ incantations in endeavouring to operate many of their cures. Their principal specific is betel-nut, and the rajah is a chief operator. His taking a piece into his mouth, and blowing on the part affected, is considered a sovereign remedy. If the complaint be a fever, a drum is beat by two men, one at each end, without intermission, until the patient either dies or recovers.

On the death of a rajah, his body is immediately conveyed to a building where all public business is transacted; the people singing and throwing stones before it on the way, and at the same time bearing their warlike implements. Eight girls sit with the body, four on each side, two days and a night, fanning it, while two lamps are kept constantly burning. The rajah generally provides himself with a coffin during his life, and he is carried to the grave by all the warriors of the place, who exhibit a sham fight. A fire is kindled at the grave after the earth is returned, and watch kept there during the night: next morning a house is erected, where the widow of the deceased, attended by her female kindred, reside during a month. But when about to leave it, a remarkable ceremony, which we believe is elsewhere unexampled, takes place. A woman or girl is barbarously murdered by the natives as a sacrifice to the manes of the deceased. Two young chiefs commence the cruel ceremony, by plunging their spears into the body of the innocent victim, who meets her fate with fortitude; and she soon falls under the weapons of others. Her head is then severed and presented to the successor of the deceased, who is no longer recognised by his former name.

Very little of the history of this large island is known to Europeans. The natives of some of the states claim high antiquity, founding their origin in fabulous traditions transmitted from their ancestors. In the year 1603, Goach had its thirteenth chief or king, and in about the middle of the last century its twenty-second. The territory of Bony had its sixteenth sovereign in 1713, and its twenty-second in 1775. It thence appears how rapidly succession takes place, and instead of between three or four generations occupying a century as in Europe, the number is infinitely greater. Probably the frequent wars of petty states contribute much more than the effect of climate to shorten the natural term of life; for it appears that very aged persons are occasionally found in the warmer regions.

In the year 1512, the Portuguese established themselves in Celebes, and are said to have assisted the natives to build the fort of Macassar, which is rather more than a furlong from the beach, and is now the principal residence of the Europeans. The Dutch, esteeming a settlement on the island of great consequence to their trade, made themselves masters of the fort in 1667; and from thence gradually extended their encroachments on the natives. Some years ago they had no less than 370 towns or villages under their controul. But the natives did not view their growing influence without jealousy, and resorting to arms, endeavoured to repel their successive aggressions. Some of the more warlike tribes laid waste their possessions and threatened to attack the fort, which they summoned to surrender. The Dutch found means to retain other tribes in their service, by whose assistance they made a sally when in the greatest danger, and obtained a signal victory. A more artful policy than force of arms was adopted, in exciting distrust among the respective tribes, so that by alternately aiding one, they could repress the power of another. Thus they lived in a state of security amidst the uninterrupted wars which have prevailed during the preceding century.

Settlements on the island of Celebes were of very great importance to the Dutch, from its vicinity to their most productive spice islands, on which account, though a yearly loss resulted from the expence of keeping up this government, they anxiously repaired them. (*c*)

CELLINI, Benvenuto, a Florentine artist, equally celebrated for the diversity of his adventures, and for his talents in sculpture, statuary, medalling, and jewellery.

Benvenuto was the son of John Cellini, the descendant of a respectable family in the family of Ambra, and was born in the year 1500. At an early age he began to shew a decided prepossession for the arts, which was probably promoted by witnessing his father's works in ivory. But here he received no encouragement, for John Cellini was bent on making his son a musician only, and used every persuasion to induce him to become a skilful performer. Though obedient to paternal command, Benvenuto's natural genius broke through all restraint, and while still a very young man, his works in gold and silver after the manner of the antique, were exhibited as admirable productions. Michael Angelo Buonarotti had then completed some of his cartoons, which inspired Cellini with an ardent desire to improve from his style.

Cellini next directed his attention to seal-engraving, under the tuition of Lautizio, the most celebrated in the art; and he also engaged in cutting dies, medalling, and enamelling, in all of which he speedily attained great perfection. He was now employed by the dignitaries of the church, and some of his works had been exhibited to Pope Clement VII., who took him into his service. After cutting seals for the cardinals, which it is to be observed were on large metallic surfaces, not engravings on stone, he struck a gold medal of the pope, which gained much applause. The proportion of gold, however, exceeding the current value of the coin, the whole were melted down, and soon disappeared. Other coins and medals, both in gold and silver, which he struck for the same pope, are said to have rivalled, if they did not actually surpass, the genuine productions of antiquity.

Cellini himself invariably testified a preference for the manner of the ancients; and some of his minor works having excited disputes among the cognoscenti, whether or not they were real antiques, the fact was frequently referred to himself.

During the course of a war wherein the pope was involved, the successes of the French emboldened them to march towards Rome. All the inhabitants immediately took up arms; and Cellini, having raised a company of men, led them to repulse the Duke of Bourbon, who was scaling the walls of the city. The duke fell on a discharge directed by Cellini; and notwithstanding the confusion occasioned by this event, the enemy entered Rome, and in the general retreat which commenced towards the castle of St Angelo, Pope Clement VII. had scarcely time to leave the Vatican. Cellini now distinguished himself as an engineer; and he himself having pointed the gun, killed the Prince of Orange while riding along the trenches. In presence of the pope, also, he killed a Spanish colonel, who had once been in the service of his holiness, on which occasion he received absolution from homicide. The pope being alarmed for falling into the power of the besiegers, laid all his regalia, and an immense quantity of jewels belonging to the apostolical chamber, before Cellini, and commanded him to take out the latter, and melt the gold. Accordingly, each precious stone was wrapped in paper, and sewed in the pope's clothes; and a furnace being erected, 100 pounds of gold were obtained from the regalia. An accommodation took place without farther extremities; and Cellini, having returned to Florence, had an opportunity of exercising all his genius on a gold medal of Hercules tearing asunder the jaws of the Nemean lion. Michael Angelo, on beholding it, declared his manner was altogether new, and recommended him for the execution of another medal, in which he was equally successful. This is described to have been a figure of Atlas supporting the heavens, which were represented by a ball of crystal, while the zodiac was imitated on a field of lapis lazuli.

Soon afterwards Cellini returned to the service of the pope, and was entrusted with the most valuable works for which he had occasion: he was appointed stamp-master to the mint, and also mace-bearer to his holiness. Not satisfied with the extent of these favours, he ventured to solicit another situation, which the pope refused, saying, if he obtained what was so considerable, he would think of nothing, and neglect his art. In this the pope was probably right, for Cellini was presumptuous and confident in his talents, which were exercised only when he judged it expedient. His temper was inflexible and capricious, and led him into constant broils, fatal to others, and nearly so to himself. He disregarded the punctuality of his engagements with the pope, and, refusing to deliver up the costly materials on which he was employed, he was deprived of his office in the mint before he had long enjoyed it. Cellini had already killed more than one person in sudden affrays, and the death of another being apprehended, he fled for safety. The pope issued his commands to seize and hang him wherever he could be found. The wounded man however recovered, and the artist, having contrived to make his peace with the pontiff, continued executing medals, which gained his highest favour and approbation. At this time Pope Clement died; and Cellini now killed another man in an affray, yet the new pope, Paul III., not only espoused his cause, but promised to reinstate him in the mint. On intelligence being received that Charles V. had made a successful expedition against Tunis, he was ordered, among other things, to make a cover for a prayer book, valued at 6000 gold crowns. This he was entrusted with delivering in the pope's name to the emperor. Though gradually rising in confidence, and employed in the most costly works, he lost the pope's favour, and withdrew to France.

Probably Cellini did not receive the patronage, on this occasion, that he expected; for after travelling some time in the retinue of Francis I., he returned to Rome.

He had now to undergo a severe trial, and became exposed to a situation of the most imminent danger. He was suddenly seized in the streets, and carried prisoner to the castle of St Angelo. The nature of his offence was not concealed, and he was accused of being possessed of great wealth, partly arising from some of the jewels, which, during the sack of Rome, were removed from the papal regalia. Cellini treated the accusation with the utmost contempt; he recapitulated the circumstances which had occurred on that occasion, and maintained that there was a list of the whole jewels taken 500 years preceding, which was recorded in the apostolical chamber, where they would still be found. He said that when Cæsar Iscatinaro came from the enemy to treat concerning an accommodation with the pope, his holiness, to propitiate the negociation, dropped a ring, worth 4000 crowns, from his finger, and on Iscatinaro stooping to lift it, requested him to wear it for his sake, which was a fact that would also probably be found recorded. Although it does not appear that there was any truth in the accusation, Cellini was detained in confinement, and the pope, in answer to the king of France's intercession for his enlargement, called him a turbulent and troublesome man, whom he had imprisoned for murder, and other atrocious crimes.

Cellini, finding no prospect of liberation, determined to make his escape from the top of the lofty tower in which he was kept. He effected his purpose with much ingenuity and success, in descending from the height; but in making farther progress, he unfortunately fell from a second rampart and broke his leg, a dagger which had been concealed in one of his boots penetrating deep into the flesh. Having crawled to the mansion of the Duke Ottavio Farnese, he was humanely received and protected, while crowds repaired to behold the inaccessibility of the place which he had left.

When Cellini had recovered from the effects of the accident, he was again carried to the castle of St Angelo, where the confinement he underwent was infinitely more rigorous than before. He was imprisoned in a dark and loathsome dungeon, infested by noxious reptiles, and scarcely supplied with subsistence for the preservation of life. The treatment he suffered was such as frequently to prompt him to lay violent hands on himself, and reduced him to the utmost despair.

By the earnest intercession of the Cardinal of Ferrara, in the name of Francis I., he was enlarged after the lapse of several years.

Cellini now repaired to France, as the king was desirous that he should enter his service, and it was fortunate that he did so, for the pope soon repented that he had granted his release. He was engaged at a liberal salary, and presented with 500 crowns to defray the expence of his journey from Italy, in the course of which he unluckily killed a man at Viterbo.

The first work in which Cellini was employed was twelve silver statues of gods and goddesses, exactly the height of the king, three of which he probably completed. He made uncommon exertions with that of Jupiter, for which he cast a magnificent bronze pedestal, bearing the rape of Ganymede, Leda and the swan, and other fabulous histories, in relief. The statue weighed 300 pounds; in its right hand it held a thunderbolt, which it was just in the attitude of throwing, and in the left was a globe of the earth. The whole rested on its gilt pedestal, on four balls, so that a child could turn it. This production raised Cellini high in the royal favour: he obtained a grant of the castle of Nello, in which his works were carried on, and also letters of naturalization. The king promised him 2000 crowns for it, and proposed to assign him the like sum yearly, from the revenues of a vacant abbey.

Cellini began to exhibit his talents in casting bronze heads and busts, and modelled a gate for the palace of Fontainebleau, which was executed with various embellishments after the antique. He also designed a colossus, 54 feet in height, which it is probable was commenced, but not completed; for an anecdote is related of one of his assistants concealing a favourite female, from her mother, in the head of it. In the mean time, his silver statues of Mars and Vulcan were making rapid progress, and he seemed to have attained the summit of his wishes, so far as respected success and reputation. He enjoyed a pension of 1000 crowns yearly, and had 40 men in his employment.

Cellini, however, neglecting to court the good offices of Madame d'Estampes, the French king's mistress, the favour of the king, if not withdrawn, was diminished; he was accused, and apparently tried for certain obnoxious crimes; his allowances run into arrear; the combination of all these circumstances led to his sudden retreat from the kingdom, where, for several years, he had been gradually rising in celebrity. The king having afterwards testified his displeasure, and demanded an account of the works he had executed, Cellini expressed his readiness to return to his service, that he might defeat the malice of his enemies, and assured him, that, so far from deriving profit, a considerable portion of his salary was still due.

Cellini had formerly been employed by Cosmo di Medici, Grand Duke of Tuscany, a liberal patron of the arts, to strike several fine medals, and was appointed engraver to the mint. Immediately on regaining Italy he was taken into his service, and, at the duke's desire, undertook to cast a superb statue of Perseus, in bronze, to ornament the grand square of Florence. In a few weeks he, with great pains, finished a model in yellow wax, about a cubit long, with which the Duke, who was an eminent judge of every thing relative to the arts, declared his satisfaction, saying to Cellini, that the statue, if cast with equal success, would exceed all others in his possession. The artist, readily pledging himself for the performance of it, commenced his operations. He formed a model in plaster, the full size of the statue, from which the cast should be made, beginning with Medusa lying at the feet of Perseus. But judging the clay of Florence unfit for his purpose, he tried its quality by previously casting a fine head of the duke. Next he cast the figure of Medusa, wherein he had used particular caution, and formed his moulds of a compound devised by himself. The statue came out so clean and perfect, that, in the opinion of other artists, to retouch it was unnecessary. Cellini was deeply interested in the completion of his work; it excited more anxiety than all the others in which he had been engaged; for he trusted that it would remain to perpetuate his renown in statuary, and a lively dispute commenced between him and his patron, whether he should be able to fulfil his undertaking.

The cast being completed, Cellini began to uncover it, when all the parts appeared in uncommon, and in what he had not anticipated, in equal perfection. Proceeding to the right foot, he was induced to conclude that the conjectures advanced by his patron, that it would be defective, had been erroneous, when uncovering it still more, he found that not only the toes, but part of the foot itself, were wanting, as he had predicted.

Some interval elapsed before the work was adapted to public inspection, which Cellini partly occupied in the necessary improvements, partly in travelling and in casting other figures. At last being exhibited in Florence, it was viewed with universal admiration, the whole city flocked to behold it, and crowds gathered round the artist, as if to gaze on one who was capable of producing so beautiful a piece of workmanship. Sonnets and epigrams addressed to Cellini, bestowing the highest praises upon him, were posted up in different parts of the city, and the grand duke, his patron, declared, that he should receive a liberal reward. Among the spectators were two Sicilian gentlemen on a mission from their own to the Tuscan government, who immediately invited the artist to Sicily.

At a late period of his life, Cellini testified a desire to be employed on a huge block of fine marble, which had been purposely quarried for a statue of Neptune. He had previously shewn himself to be an able sculptor, and in particular had restored a mutilated Ganymede of Grecian workmanship, with surprising art. Being disappointed of this, he engaged in a crucifix with much anxiety, with which there seems to have been mingled a great degree of devotion. He was the more stimulated to exertion, from believing himself the first who sculptured crucifixes in this substance. This work, which Cellini presented to his patron, the grand duke, received the same applause with his other performances, and gave birth to several sonnets from admirers of the arts.

Cellini was now advanced in life, and it does not appear that he produced any thing more of great celebrity, though his presence was courted by crowned heads in other kingdoms. He died 13th February, 1570, and was interred with great ceremony in the church of the Nunziata in Florence, the whole members of the Florentine academy being present.

Cellini, as an artist, rivalled, if he did not surpass, all his contemporaries, the celebrated Michael Angelo being scarcely excepted. His jewellery, medals, vases, casts, and sculptures, have been alike prized, and are still the objects of anxious search. He enjoyed the good fortune of living at a time when eminent abilities, and not constrained or artful commendation, could bring their possessor into notice, and when genuine taste for elegant design and sculpture prevailed. Neither did he languish in obscurity; for he perhaps experienced more distinguished patronage than any other artist can boast. But all his successes were interrupted by a violent and irascible temper, which constantly involved him in difficulties, which prompted him to commit more than one assassination, and which would scarcely permit him to treat his superiors with deference. He was jealous of those talents which he was too conscious he possessed, and though he respected those of Michael Angelo, Donato, and a few of his contemporaries, he was accustomed to undervalue the qualifications of many artists whom the public admired.

Besides the productions of art which came from Cellini's hand, he wrote his own memoirs in the Italian language, a narrative replete with entertainment. But he wisely abstained from publishing it, which was done long after his decease. He also composed a skilful work on the arts that he chiefly practised, which was published towards the close of his life. This is highly celebrated by Vasari, and it certainly bears incontestible evidence of comprehensive genius and originality: unlike his memoirs, it exhibits temperate reasoning. It is divided into two parts, in the first of which he treats of jewellery, enamelling, coining, the art of making gold and silver vases, and of silver statues larger than life. The second is dedicated to details on the mode of casting statues in bronze, on the quality of marble for statuary, the fabrication of colossal figures, and a discourse on the art of design. The originals of these works is extremely rare in Britain. See *Life of Cellini*; Vasari *Vite de Pittori Museum Florentinum*, tom. v.; Cellini *due trattati dell' Orificeria*. (*c*)

CELLULAR SUBSTANCE. See ANATOMY, p. 732.

CELOSIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 159.

CELSIA, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 144.

CELSUS, an Epicurean philosopher, who flourished in the second century, and is chiefly distinguished as one of the early and most violent opposers of Christianity. Of his life nothing is now known; but it was probable that he was a person of some celebrity, as Lucian has dedicated to him his *Pseudomantis*. His principal work, which he wrote against the Christians, and which he entitled λογος αληθης, *The True Word*, is now lost; but its arguments and objections are preserved in the excellent answer of Origen, which Du Pin characterises as the completest and best written apology for the Christian religion which the ancients have left us. In this treatise, Origen has not merely given us the substance of Celsus's objections, but has fairly stated them in the very words, and in the order in which they were set forth by their author; so that from these extracts we are enabled to form a tolerably correct estimate of Celsus's reasoning and abilities. Though it must be admitted that many of his objections are frivolous, scarcely deserving a serious refutation, and betray rather a spiteful desire of throwing obloquy upon the Christians, than an honest wish of meeting their opinions and morals with logical reasoning, and a candid statement of facts, yet we cannot join entirely with those who represent him as a trifling caviller, or a futile calumniator. His arguments display considerable ingenuity and learning, and prove him to be perfectly versed in all the arts of controversy. It is indeed no small praise, that his book was considered worthy of an answer from the pen of Origen; and, to its credit, we may also observe, that it may be considered as the great armoury from which almost every weapon has been drawn which has been pointed against our religion since the days of Celsus. Modern cavillers have gone over the same ground, and insisted upon the same objections, as their great predecessor; and their answer, as well as his, is to be found in the Apology of Origen. But however the opponents of Christianity may have been indebted to him for their principal arguments, its advocates have also profited by his admissions; and, consequently, we are disposed to be equally grateful with them for the advantages that may be derived from his writings. His testimony to the books of the New Testament is peculiarly valuable; for, while he misrepresents and perverts the facts which they contain, he bears evidence of their truth; and this evidence is the more considerable, as it is altogether beside the intention of the author. Of the fragments of Celsus's work, which are preserved by Origen, there are three summaries in the English language, viz. one by Dr Doddridge, one by Dr John Leland of Dublin, and another by Dr Sherlock. Besides his λογος αληθης, a piece against magic is ascribed to him both by Origen and Lucian; and he is also said to have promised another work, in which he undertook to shew, how men should live who would follow the rules of philosophy; but it is not known whether that work ever appeared. See Lardner's *Works*, vol. viii. p. 6, &c.; Mosheim's *Ecclesiastical History*, vol. i. p. 163; *Du Pin*, vol. ii. p. 454; Fabr. *Bib. Græc.* tom. ii. p. 809; and Paley's *Evidences*, vol. i. p. 294. &c. (*h*)

CELSUS, A. CORNELIUS, an eminent physician and philosopher, who is supposed to have written towards the end of the reign of Augustus, or, at latest, in the beginning of that of Tiberius. All that is known of his history, is merely that he was a Roman; but what was his situation in life, and whether he practised any branch of medicine, or was only an amateur in the art, has not been completely ascertained. In many parts of his work *De Medicina*, however, he appears to speak frequently from experience; and it can scarcely be conceived, that such a perfect knowledge of the art as he has displayed, both concerning the most difficult operations of surgery, as well as the nature and treatment of diseases, could have been acquired without long practice and application. After describing a particular method of cure used by Heraclides in the adhesion of the eye-lids, he adds, "*Ego sic restitutum neminem memini*, (*De Medicina*, lib. viii. c. 7.); "I remember of no person being cured in this way;" which expression evidently implies, that he himself had exercised the profession, or otherwise he would not have ventured to place his own experience against the success of any cure recommended by others. Numerous similar expressions may be adduced, equally strong, in favour of the supposition that he practised the medical art; but Dr Grieve concludes, from a severe censure (*De Medicina*, lib. iii. c. 4.) which Celsus has passed upon those physicians who often neglect their patients by engaging in too extensive a practice, that his practice was confined to his acquaintance and friends, and that his fortune and generosity rendered him superior to the view of living by the profession. But, whatever was his station in society, his writings have recommended him to the admiration of posterity. His treatise on medicine is often quoted with approbation by our best writers on physic, and contains all that is most valuable in the works of Hippocrates. According to Boerhaave, indeed, it is to Celsus that we are indebted for the opinions and true meaning of many parts in the writings of that father of physic, which would otherwise have been unintelligible or misunderstood. But, in addition to the extent and correctness of his medical knowledge, he is distinguished for the purity and elegance of his latinity, which entitle him to be ranked among the first writers of the Augustan age. Celsus is said to have written treatises upon several other subjects, particularly upon rhetoric and agriculture, but none of them have been handed down to our times. The former is frequently quoted by Quintilian, and, though he often differs from him in opinion, yet he bears honourable testimony to his learning and acquirements. When recommending to orators to make themselves masters of all the sciences, after mentioning Homer, Plato, Aristotle, Cato, Varro, and Cicero, some of the greatest geniuses that ever appeared, he adds, "Why should I name any more instances? when even Cornelius Celsus, a man of a moderate genius, has not only composed treatises on all these arts, but has also left precepts of the military art, agriculture, and medicine. The bare attempt requires us to believe that he understood all these subjects; but to give perfection to so great a work is a difficult task, to which no man has ever been found equal," (*Inst. Orat.* lib. xii. c. 11.) Columella, also, in his work *De Re Rustica*, lib. ii. c. 2. frequently mentions him with great respect, comparing him with the best writers on husbandry, and represents him as one who was "not only skilled in agriculture, but who took in the whole compass of natural knowledge." His merit as an author is sufficiently indicated by the numerous editions through which his work *De Medicina* has passed, and by the high esteem in which it is still held. The best edition is supposed to be that of Almeloveen, which was edited at Padua in 1722, by Vulpius; and there is a good English translation by Dr Grieve, published in 1756. See Le Clerc *Hist. de Med.*; and Friends' *Hist. of Physic.* (*p*)

CELTIS, a genus of plants of the class Polygamia, and order Monœcia. See Botany, p. 337.

CELTS, an ancient people inhabiting, according to the earliest historical notices, the western parts of Europe.

It appears now to be generally admitted, that the Celts were a peculiar people, distinguished by many remarkable particulars from the Scythians or Goths, with whom they have been often confounded. The distinction, however, between the nations alluded to, has not been admitted without a full and elaborate discussion of the subject. Many learned authors have contended for their identity; all antiquity has been explored by the writers on opposite sides; and, upon a question which surely might have been discussed with a due attention to good manners, much bitterness and insolence have been shewn. Among those who have contended for the identity of the Celts and Goths, a principal place must be assigned to Cluverius and Pelloutier; and likewise, though he contends for nothing more than an identity of origin, to the late Sir William Jones: while, of all the champions for their diversity, Mr Pinkerton, aided by a profound and acute writer in the second volume of the *Edinburgh Review*, is by far the most formidable. The points supposed to be established by Mr Pinkerton and the learned critic, are the following: 1. At a period, probably as early as the year 1400 A. C. the Scythians had pushed themselves from the vicinity of the river Araxis, westwards and northwards, over a considerable part of Europe. 2. The Scythians were afterwards mentioned in history under the names of Getæ, Gothi, and Germani; but whether distinguished by these names, or by the more comprehensive appellation of Scythæ, the people thus distinguished were one and the same. 3. With regard to the Celts, the earliest notices would lead us to place them about the year 500 A. C. in the neighbourhood of the Pyrenees, whence they were driven by the Germans or Goths on the east, and the Aquitani, probably an Iberian race, on the south, into that part of Gaul where they were found in the time of Cæsar. 4. That the inhabitants of the Highlands of Scotland, and the Welsh, together with some of the Irish tribes, are the remains now existing of the ancient Celts. 5. That when the Greek and Roman authors use the words Κελται and Γαλαται, Celtæ and Galli, they often refer exclusively to the Belgic Gauls, (see the mass of authorities quoted in the *Edinburgh Review*, vol. ii. p. 365, *art.* Vindication of the Celts.) 6. That though this is frequently the case, the distinction is sometimes accurately made between the Belgic Gauls and the Celtic; as in the introduction to the first book of Cæsar's *Commentaries*, where the Belgæ are represented as inhabiting one part of Gaul, the Aquitani another, and the Celtæ a third; and in the language with which the account of the Druids, given by the same author, commences, *In omni Gallia, eorum hominum, qui aliquo sunt numero atque honore, genera sunt dico.—In omni Gallia*, that is, as the passage is commonly understood, in all the Celtic part of Gaul.

We may consider the distinction between the Celts and the Goths as established, *first*, By the difference of their person; 2*dly*, By the difference of their religious belief, and sacred observances; 3*dly*, By the difference of their political institutions; and, *lastly*, By the difference of their language. In pointing out these differences, almost every thing interesting in the history of the Celts may be conveniently brought into view.

1. The Celts were distinguished from the Scythians, Goths, or Germani, by their external appearance. They had not the light hair and blue eyes, which were regarded in ancient times as an indication of a German origin; nor had they the lofty stature and large limbs, which are still considered as characteristic of the German tribes. It was to their extraordinary appearance and ferocious aspect, as well as to their barbarous valour, that the Gauls (of Scythian or Gothic extraction) were indebted for their victories over the Romans; and, before the strength and discipline of Rome could match the prowess of these fierce invaders, it was necessary to familiarize the legions with the tremendous looks and savage howling of the Gaulish warriors. On the other hand, the Celts were a people of an inferior stature, swarthy in their complexion, with dark eyes, and hair short, coarse, and black. In their external appearance they seem to have resembled the Finns and Laplanders of modern times. History records but little of their victories and conquests; and Mr Pinkerton, in frantic declamation, pronounces them to be radical savages, incapable of instruction or progress in society.

2. But if the Celts were distinguished from the Goths by their external appearance, they were distinguished from them, in a still greater degree, by their religious belief and their sacred observances. Among the Celts there existed a hierarchy, regularly constituted and established: a class of men exercising the functions of the priesthood, and extending their authority over every department of civil life; clearly marked out, and separated from the rest of the community, and enjoying many and exclusive privileges. Our readers will perceive, that we allude to the Druids. It is universally acknowledged, that Druidism was peculiar to the Celts, and that nothing resembling that extraordinary system was to be found among the Gothic or Teutonic tribes. This difference is striking and fundamental: And the fact, that the Germans had no Druids, is mentioned by Cæsar as a circumstance completely discriminative of the Celtic and Gothic nations. It has been affirmed, that the Druids were not unacquainted with the great and primary truth of the unity of the divine nature. But if this was the case, and if the notion alluded to formed a part of their secret creed, or what the Greeks would have called their *isoteric* doctrine, we have sufficient authority for maintaining, that they countenanced, at the same time, the belief and the worship of many gods, as Jupiter, Mars, Apollo, Mercury, and Minerva, or beings of heavenly origin and power, whose attributes and office corresponded with those of the principal divinities of Rome. They held likewise the doctrine of Metempsychosis, or the transmigration of souls. Of a general receptacle of spirits, enjoying various degrees of happiness, or doomed to various measures of suffering, they appear to have had no idea. Their notion seems to have been, that the soul of man is destined to occupy various bodies in succession; and that the alternate transference and residence of the thinking part were to be continued for an indefinite length of time, beyond which the enquiry was not pushed. In addition to all this, it must be stated, that the Druids were philosophers. They had raised their understandings above the first wants and enjoyments of our species. They had attempted to pierce into the recesses of nature. Their investigations related to the constitution of the physical world, the motion of the heavenly bodies, the size and figure of the earth, and the power and purposes of the immortal gods. Schools of philosophy were established among them. What they knew, they taught the youth committed to their care. These were generally the sons of nobles, and persons of distinction. Some of the pupils spent no fewer than twenty years under the tuition of the Druidical college. It was a principal part of their education, to treasure up in the memory a very great number of verses, in which the mysteries of science and of religion were unfolded; for these ancient masters of Celtic wisdom, though acquainted with alphabetical characters, made no use of them in the schools over which they presided. Into the schools alluded to, the vulgar were not permitted to enter. It seems to be an acknowledged principle of the Druidical system, to keep the people in perpetual ignorance; and we shall immediately see, that it was a part likewise of their system, to keep them in a debasing and pitiable state of political subjection. See Druid.

In almost every particular mentioned above, the German nations appear to have differed from the Celtic. They had no separate class of men exercising the functions of the priesthood, and enjoying the privileges of exemption from taxes and from military service. Their ecclesiastical officers (for they deserve no better name) were nearly as ignorant as themselves. The notion of a direct immortality, in contradistinction to that of a Metempsychosis, was prevalent among them. And the chief pleasure of the Gothic paradise,—a pleasure in which none but the brave and victorious soldier was allowed to participate,—consisted in drinking ale out of the sculls of his enemies whom he had slain in battle. They had no institutions corresponding to the Druidical schools; no philosophy; no doctrine, either secret or divulged; nothing kept hid from the people, because there was nothing to be concealed.

3. In their political institutions likewise, a considerable difference appears to have existed between the Gothic and Celtic tribes. Among these tribes, the state of the people, regarded as distinct from that of the privileged orders, seems to have varied in a most extraordinary degree. In the one great class of human beings, the people were free, and valued themselves upon their liberty; in the other, they were doomed to obey, and satisfied with subjection. Among the Goths and Germans, every man was a soldier, consulted on occasions of the highest political importance, and listened to with that attention to which a free man is entitled. Among the Celts, every man who could not establish his claim to be ranked with the Druids or the knights, was a slave: his comfort or misery, his life or his death, depended almost exclusively upon the will of his master. In order to shew that the difference now alluded to really existed, we shall just set down, in opposition to one another, two short sentences extracted from Cæsar's *Commentaries*, the one referring to the state of the people among the Celts, and the other referring to the state of the people among the Scythians, Germans, or Goths. The passage relating to the Celts is the following: "*Nam plebes, pæne servorum habetur loco, quæ per se nihil audet, et nulli adhibetur concilio.*" (De Bello Gallico, lib. vi. c. 12.) They were, in point of fact, only the instruments of their superiors. The passage which relates to the Germans or Goths, is in these remarkable words: *Atque ubi qua*

ex principibus, in concilio se dixit ducem fore, ut qui sequi velint profiteantur, consurgunt ii qui causam et hominem probant, suumque auxilium pollicentur, atque a multitudine collaudantur." (De Bello Gal. lib. vi. c. 22.) When any one of the chiefs, (so the words may be rendered,) proposes himself as a leader in any expedition, they (not the chiefs, but the people,) who approve of the undertaking, and of him who engages to execute it, signify their approbation, and promise their support, amidst the applauses of the whole assembly. That this is the true meaning of the passage last quoted, we learn, beyond the possibility of doubt or difficulty, from the declaration of Tacitus with regard to the same people: "*De minoribus rebus, principes consultant, de majoribus, omnes.*" De Mor. Germ.

Among the Gothic nations, the commencement of what has been called the feudal system, may easily be traced. The chief men were possessed of authority and influence; but their authority was exercised within considerable limits, and their influence subjected to considerable restraint. In matters of inferior concern, the decision of the chief was final, but all affairs of high interest were discussed and determined by the people at large. It is to the power of the chiefs thus restrained, and to the mode of civil government connected with it, that Mr Pinkerton has given the name of the feudal system in its purity. And according to the opinion of that learned gentleman, this feudal system in its purity is carefully to be distinguished from the latter feudal system, or that system in its corrupted state. Among the Celts, on the other hand, while the chiefs commanded the armies, and were in other respects not destitute of power, the supreme judicial and even legislative authority appears to have been engrossed, almost entirely, by the other privileged order, that of the Druids. The Druids judged in all controversies, whether public or private, whether of a civil or of a religious nature. They ordained and inflicted punishments. If any one refused to abide by their decision, he was instantly excluded from the sacred observances; he became the subject of a most severe excommunication; he was held as accursed; he was avoided as a person on whom the mark of the divine displeasure had been set; he lost all claim to justice, and all title to protection. In one respect, however, the two cases, that of the Goths and the Celts, considered in a political point of view, may justly be said to agree. In both, the power of the chief was limited; but among the Gothic tribes, the check proceeded from the people, the voice of freemen was raised aloud against oppression; while among the Celts the power of the chiefs seems to have been nearly absorbed in that of the Druids, and the voice of the people, if heard at all, was noticed, only as a symptom of rebellious insolence, and marked only to be punished.

4. The last point of difference between the Celts and the Goths, is their language. It is not to be denied, however, that in ascertaining this point of difference, considerable obstacles present themselves. It is not easy to procure correct specimens of any ancient language, and even when correct specimens have been obtained, it is not easy to determine whether the language be pure. With the exception of tribes debarred by physical circumstances, there is, perhaps, no instance upon record, of a people living for a very great length of time in utter seclusion from the rest of the world, retaining their original language, in all its purity, and their manners in all their characteristic features. Intercourse must always take place, in a greater or less degree, among contiguous tribes. Their very hostilities lead to intercourse; and wherever intercourse is supposed, characteristic features, either of language or of manners, will gradually pass away. Besides, if there be any truth in the opinion of Sir William Jones, that the Celts and Goths, though differing exceedingly from one another at the periods to which the Greek and Roman historians refer, were nevertheless, originally, or with regard to their present stock, the same people, we must expect to find the same elementary words in the speech of both nations. However diversified in its general appearance, the *substratum* of their language will be the same; traces of the native tongue will be discoverable in both; just as in the various languages of Europe which have been derived from the Latin, sufficient indications of a common origin may still be perceived.

In their state of comparative advancement, however, the language of the Celts appears to differ very obviously from that of the Goths. We have specimens of both tongues, as well as of their kindred dialects, given by Dr Percy in his Preface to the work of M. Mallet, a work which, together with the Preface now mentioned, has so often been quoted and referred to by authors on this subject. Indeed the means of deciding the question of the identity or diversity of the languages alluded to, do not appear to be very remote or inaccessible. There is a Gothic Version of the Evangelists, which has frequently been published (by Junius, 4to, 1665, and by Lye at Oxford, 1750.) And since the year 1750, a fragment of the Epistle to the Romans, likewise in the Gothic tongue, has been discovered at Wolfenbuttel, and published by the Rev. F. A. Knittel, archdeacon of that place. The versions of the New Testament into the Gaelic or Erse language are sufficiently numerous. See Cluverii, *Germania Antiqua*; Pelloutier, *Histoire des Celtes*; *Edinburgh Review*, vol. ii.; Mallet's *Introduction to the History of Denmark*, translated by Bishop Percy, and published under the title of *Northern Antiquities*; Pinkerton's *Enquiry into the History of Scotland*, and *Dissertation* annexed. (*h*)

CEMENTS. This term is of very extensive signification, comprehending every substance employed for the purpose of connecting together other substances. It, therefore, comprises the whole of those substances used by chemists to close the joinings of chemical vessels; to repair flaws, or to coat the exterior parts of those vessels which are subjected to the action of heat.

Occasionally cements are employed for coating vessels that are to be exposed to a very considerable heat; and the process is called *lorication*, or coating. Iron furnaces are generally coated in the inside, to prevent the destruction consequent on continued exposure to the action of the fire.

For the common purposes, such as to prevent the escape of steam, the vapours of alcohol, or of any other liquid which is not corrosive, slips of bladder which have been soaked in warm water until they become adhesive, answer extremely well for glass; and paper, with paste, for metallic tubes. A solution of gum arabic, or the white of an egg, increases the adhesiveness.

Linseed meal, or almond paste, well beaten up with water, so as to form a pretty dense paste, form a very firm lute for common purposes. But it is unfit for a higher temperature than that of boiling water, or for the continued action of acrid gases. It will, however, confine ammoniacal and the acrid gases sufficiently long for the usual experiments. Milk, lime water, or a weak solution of glue or size, improves it considerably.

Many very impervious lutes are made with quick-lime as a basis. This quick-lime is reduced into a ductile mass by an admixture of some mucilaginous matters. As combinations of this sort are obviously very numerous, we shall give only a very few of them.

Take some lime that has been perfectly burnt, dip it into water, and allow it to fall into a very fine powder, which it will readily do if the calcination has been complete, and then beat this powder very carefully with equal parts of the white of eggs and of water, to the consistence of thin paste. The lute thus formed should be laid on thin slips of cloth, and applied to the junction of the vessels to be luted. If a small quantity of the powdered lime be sprinkled upon the slips of cloth, the junction will be rendered more complete. The same lute may be made in a simpler way; take thin slips of cloth, moistened with the white of eggs, and sprinkle them over with the powdered lime. This last mode has the advantage of drying with great rapidity.

Lime mixed with dissolved glue also forms a very excellent cement; and, when the white of eggs are added, the *lut d'ane* is then formed. The above lutes, however, do not resist the action of water, though they are quite impervious to vapours.

Very poor skimmed milk cheese, rubbed down to the consistence of thick soup, with the addition of lime, makes a good lute.

Paris plaster, mixed with any mucilaginous matters, is useful as a cement. Sometimes other substances are added, as clay, flour, red oxide of iron, &c.

The calcareous lutes become extremely hard, and it is difficult to free vessels from them. They are therefore not proper where delicate vessels, which are to be preserved, are employed. In large works, or in experiments where large vessels are used, it is well to have a quantity of them at hand, as they are very convenient for stopping up any accidental crack, either of the lute originally applied, or of the vessel itself. It may be also observed, that these lutes will not confine acrid vapours for any length of time; but for every other purpose they are admirably adapted, particularly where heat is necessary.

The fat lute, as it is commonly called, is of very general use, but peculiarly so when exposed to acid vapours. It also possesses another advantage, that of being never hardened to an inconvenient degree. Any good clay, such as pipe clay, or potter's clay, perfectly dry, must be reduced to a very fine powder, and then gradually beaten into thick paste with *drying* linseed oil. The beating must be continued until the mass ceases to adhere to the pestle. It improves from being kept in a covered vessel, in a cool situation. It becomes quite fit for use by being beaten up again for a few minutes with a few drops of lintseed oil.

The above may be considered as constituting by far the most generally useful lutes for connecting chemical apparatus together; there are, besides these, another class of lutes, which is of high value to the practical chemist, and of some of them we shall now give a short account. As glass vessels, when subjected to a considerable temperature, are liable to melt, they are frequently coated with lutes, which protect them, and obviate the inconveniences which would result from complete exposure. Earthen vessels being naturally porous, are apt to allow any volatile matters contained in them to escape; this is also remedied by similar means. To secure glass vessels, sand is mixed with as much clay as binds the whole mass together, and is beaten up with any fibrous matter, which gives an additional degree of mechanical security. Windsor loam answers well; but an equally useful cement may be formed from an admixture of sand and coarsely ground potter's ware; to which horse dung, chopped straw, chaff, horse or cow's hair, or tow, may be added, in such proportions as will render the whole mass perfectly ductile. An ounce of hair is said to be sufficient for five pounds of the earthy mixture. The mass should be beaten together with great care, so as to diffuse the hair throughout the whole of it. It may be then applied to the surface, to be coated either in the dry state, or by repeated dippings into a thick mixture of the mass with water. If the coating be smeared with lintseed oil after it is thoroughly dry, it will be less liable to crack.

As a coating for earthen ware vessels, various compounds may be formed of a variety of fluxes, mixed into a thin paste with clay and lime. One ounce of borax dissolved in a pint of boiling water, added to as much lime as will form a thin paste, will be an excellent coating of this kind. After this has been applied to the earthen vessel, and has become properly dry, a lute of lime and linseed oil should be laid over the whole. When it is completely dry, the vessel is fit for use. By renewing the last lute, the vessel may be used several times with safety. This preparation has been chiefly recommended as a coating for vessels in which phosphorus is prepared.

It is frequently necessary to lute the covers of crucibles, so as to exclude any communication with the external air; and it is an object of importance, to have a lute that can bear a high temperature. An excellent compound of that kind is formed by borax first calcined and then fused, brick dust and clay finely powdered, and moistened with a little water. About a tenth of the whole may be borax. Litharge may be used, though it is inferior to the borax.

Clay, iron filings, and water, make a durable cement for iron vessels exposed to a high temperature.

Very useful lutes are made of oily substances united to resinous matters. They answer extremely well at a moderate temperature, and with those vapours that do not dissolve their component parts. They will adhere to glass, which enhances their value. Bees' wax, softened with one-eighth of the spirits of turpentine, forms a cement of this kind.

One part of bees' wax, four of rosin, melted and mixed up with one part of brick dust finely powdered, forms the cement used by turners, with which the handles of knives are cemented to their blades.

Equal parts of pitch, turpentine, and wax, boiled till the essential oil is dissipated, makes a coating to a wooden chamber, which is perfectly impervious to the vapours of sulphureous acid. It is therefore useful in the manufacture of alum. Suet and wood ashes make a simple cement, which is well adapted to stop leaks in casks.

Gum arabic, dissolved in water, is a cement well known for applying paper to glass, &c. Isinglass, dissolved in vinegar, is still better.

The following formula has been given for a cement to unite glass or steel:

"Take of mastich five or six bits as big as peas, dissolve in as much alcohol as will render them liquid. In another vessel, dissolve as much isinglass (previously soaked in water) in brandy or rum as will make two ounces, by measure, of a strong glue, warm it, and incorporate with it, by rubbing, two or three small bits of galbanum or ammoniacum, and then add the mastich solution; keep the cement in a bottle well stopped, and gently warm it before use."

Of late, the use of cements in chemical experiments has been nearly superseded by the introduction of accurately ground glasses, which, without the introduction of other substances, may be made perfectly air tight. Much inconvenience certainly arises from the use of them, which is thus obviated. They still, however, are necessary in many large manufactories, and are retained by the practical chemist. See Bridge, p. 510; *Appendix* to Chemistry; and Civil Architecture. (c. m.)

CEMETERY, a place appropriated for the reception of the dead.

In order to free the living of the dangerous and offensive miasmata of dead bodies, almost all nations have done something towards their speedy removal or destruction. Some cast them into the waters, others carry them from their dwellings to sequestered places, and some reduce them to ashes, or deposit them entire in the earth.

In a savage state, each member of a family is interred by his immediate relatives near the spot of his decease; or bodies are, in the same way, consumed by fire. Thus the untutored native of the Australasian regions, as we have seen, raised a bier for his departed wife, and, unassisted, consigned her ashes to the dust. The remote inhabitants of the north, precluded by perpetual frosts from penetrating the ground, cover their deceased with the branches of trees, to prevent them from being devoured by beasts of prey. Though the ties of consanguinity be recognised by mankind farther advanced in civilization, it does not appear that they are careful to deposit the bodies of relatives in the immediate vicinity of each other. Hence particular cemeteries, or those for common use, are unknown.

Yet it has anxiously been desired by men in general, that their bones should rest in the soil of their nativity. When the Nomadic tribes of South America, wandering many hundred miles from their proper boundaries, lose one of their number, they make a skeleton of his bones, and carry it on his favourite horse to the cemetery of his family, however distant. Certain tribes make skeletons of all their deceased, which are placed in a sitting posture, clothed in robes and feathers, in the cemetery. Every year the cemetery is opened, and the skeletons are cleansed and clothed anew. In another portion of that vast continent a pious festival is celebrated, wherein each person carries the putrid and decaying carcase of his father on his shoulders in solemn procession, and again returns it to the earth.

The cemeteries of the Jews, were caves and grounds apart from their cities. Abraham, we are told, purchased the field of Mackpelah, and there buried Sarah his wife in a cave, wherein he himself was afterwards deposited. The Israelites buried the bones of Joseph which they had brought out of Egypt, "in a parcel of ground which Jacob bought of the sons of Hamon;" and the Jewish laws particularly ordained the interment of criminals who died by the cord.

Other ancient nations, such as the Greeks and Romans, though they burned their dead, had cemeteries without the cities for depositing the urns containing the fragments of bones and ashes. Cremation did not invariably prevail, and it was not unusual even to make the house or garden of the deceased his cemetery. But among the Romans, the emperor Adrian prohibited sepulture within the city, and there was a cemetery beyond its walls appropriated for the poor; the other cemeteries for persons of rank or fortune were generally near a highway. The Campus Martius was the cemetery of distinguished characters.

The modern Turks and Chinese imitate the Greeks and Romans, in placing their cemeteries without their cities. They are generally situated on eminences, and abound with cypress trees. The Chinese never inter in a grave previously occupied, at least before all the remnants of the former body have disappeared, and therefore their cemeteries occupy a large surface of ground. If unfortunate in life, the son sometimes digs up his father from the grave, to propitiate his destiny.

The ancient cemeteries in Great Britain were of various descriptions. Barrows or cairns denote the sepulture of celebrated persons, commonly, it is conjectured, those who fell in battle. The author of this article some years ago opened a cemetery in Scotland, which probably ascends to a period of remote antiquity. Numerous coffins, for the most part of small size, were formed of rude slates, built round for sides: they were almost level with the surface of the earth, and the edges of some of the slates were visible above it. Their site was on a thin soil, covering rock, though deep earth was in the immediate vicinity. These coffins did not lie east and west, but some almost due north and south, from which it may be inferred they had been used anterior to the introduction of Christianity. Many contained fragments of bones, and some teeth very entire.

The cemeteries in this kingdom are either public or private, and frequently in the centre of crowded cities. Formerly it appears, that fairs and markets were held in public cemeteries. A Scotish law of 1594 ordains, that each is to be surrounded by a wall two ells in height. Within the precincts, portions generally belong to individuals, which are private property. This was very recently decided by the supreme court of justice in Scotland, in the case of an officer who had been accidentally killed, being, without authority, interred in a private burying place. The owner having complained of this invasion of his rights, the body was ordered to be dug up, and interred elsewhere.

Long ago, the superstitions of mankind converted churches to cemeteries, a practice which is yet perpetuated. But this indefensible custom was not introduced without resistance; and about the year 381, there is one rescript in the Theodosian Code, which may be interpreted. "Let none suppose, that the churches of the apostles or martyrs are to be rendered ordinary places of sepulture;" and another explicit prohibition, that "no one shall bury in a church." Constantine, the first Christian emperor, had previously been interred in the porch of a church which he had erected to the apostles, A. D. 337, on which St Chrysostom observes, that "The emperor was greatly honoured in the interment of his body being permitted at the door of the temple, and that he should be porter to fishermen." Various ecclesiastical canons contain decrees on the subject. The Spanish Council of Bracara, in 563, ordained, that every cemetery should be without the church. Theodore, patriarch of Antioch, in 1180, decreed, that it should never be lawful to bury in churches, according to the civil law of the Grecian empire. The Council of Nantes permitted the porch of the church to be converted to a cemetery, but prevented interment in the interior: and an ecclesiastical council held at Tribur in Germany, prohibited the laity only from finding a cemetery within its walls.

But interment in churches gradually came into universal use in Roman Catholic countries, first, from the anxiety of devotees to have their remains deposited near the relics of some favourite saint; and, secondly, from the benefit which thence resulted to the ecclesiastics who officiated there. All sacred things were rendered the subject of traffic; sepulture in a consecrated place, the remission of past sins, and indemnity for those to be committed, had their fixed and appointed prices. Certain perquisites were due to ecclesiastics for interment in the cemetery within their boundaries, which were rigorously exacted, and which it was dangerous to refuse. The heir of the deceased declining compliance, was in hazard of excommunication. Such perquisites were called mortuaries, a remnant of which may still be recognised in the hire of the pall or mortcloth at funerals.

The danger of burying in churches, and of having cemeteries in large towns, has sometimes been fatally exemplified. Some years ago, on preparing a grave for a person of rank in a church near Nantes, the body of a near relation, who had died nine months preceding, was displaced. The coffin was accidentally shattered, and an infectious principle instantly diffused itself around, with such virulence, that no less than fifteen persons of those attending the funeral died within eight days.

Cemeteries, in Christian countries, are consecrated ground: and as such, infants dying before baptism are with us denied sepulture in it, along with others. Roman Catholics, however, do not esteem the cemeteries of Protestants sufficiently sacred to receive their ashes. The origin or cause of consecration is extremely obscure: in the fifth century, it is said to have been unknown, and, according to Gregory of Tours, was introduced about the year 590. Perhaps it has been preserved, to demonstrate the right of ecclesiastics to the mortuaries of the deceased persons deposited there: and though these are abrogated, the clergyman of the parish in this kingdom is entitled to the grass that grows in the church-yard, though it has been decided by courts of law, that he cannot pasture his cattle there.

In most nations a custom has prevailed, of planting public cemeteries with trees, though one of the continental councils pronounced a decree against it in 1565. *Ex cimeteriis, arbores frugiferæ, et aliæ etiam infrugiferæ cujusvis generis, aut arbusta stirpesve omnino convellantur atque excidantur.* The cypress was an emblem of mourning among the Romans: it was seen at the pile of the deceased, and in the cemeteries; and to warn priests who were defiled by the sight of a corpse against entering for the celebration of religious rites, it appeared on the outside of the door of a house, whenever a dead body was within. The cemeteries of the Turks and Chinese are planted with cypress trees: in Britain, for centuries past, the yew has been chosen. An opinion has been entertained, though with little reason, that an evergreen has thus been selected as an emblem of the immortality of the soul; and hence the practice of decking the coffin with bays, and carrying branches before the bier. Perhaps it may have been designed as a more permanent mode of testifying that attention to the deceased, which was practised by the ancients. They scattered flowers on the pile, on the urn, and in the cemeteries of their departed friends. Thus Virgil, in describing funeral ceremonies, says,

> Purpureos jacit flores, ac talia fatur.—ÆNEID, *lib.* v
>
> Manibus date lilia plenis:
> Purpureos spargam flores. ÆNEID, *lib.* vi.

The same ceremony was known to the ancient Christians; whence, St Ambrose, in his eulogy on Valentinian, says, *Nec ego floribus tumulum ejus aspergam sed spiritum ejus Christi odore perfundam: spargant alii plenis lilia calathis.* "I will not strew his grave with flowers, but pour on his spirit the odour of Christ: let others scatter baskets of lilies." St Jerome, in a consolotary epistle to a surviving husband, observes, that while "other husbands strewed the graves of their wives with violets, roses, lilies, and purple flowers, Pamachius bedewed the ashes of his with the balsam of alms."

Those pious customs are not altogether obliterated among ourselves. In some parts of Wales, the graves are adorned with certain flowers, denoting the age of the deceased: the violet, the rose, or plants of rue, being appropriated to the three different stages of life. Fences or borders are made of them, which are carefully preserved from decay, and cleared of obtrusive weeds by the nearest surviving relatives. Each Saturday afternoon is devoted to this office. In other parts of the world, the women come frequently to pray or lament in the cemeteries, and scatter herbs above the graves.

See Cunæus *Respublica Hæbræorum*; Gregorius Turonensis *de Gloria Confessionis*; Ambrosius *Oratio Funebris de Morte Valentiniani*; Hieronymus *Epistola ad Pammachium*; Gutherius *de jure Manium*; Navier *sur les Dangers des exhumations precipites*; *A seasonable consideration on the indecent and dangerous custom of burying in Churches*; Birnie's *Blame of Kirk Burial*; and Brand's *Popular Antiquities*. (*c*)

CENARRHENES, a genus of plants of the class Tetrandria, and order Monogynia. See Botany, p. 124; and Brown's *Podromus Plant. Nov. Holl.* &c. p. 371.

CENCHRUS, a genus of plants of the class Triandria, and order Monogynia. See Botany, p. 95.

CENIA, a genus of plants of the class Syngenesia, and order Polygamia Superflua. See Botany, p. 305.

CENTAUREA, a genus of plants of the class Syngenesia, and order Polygamia Frustanea. See Botany. p. 300.

CENTAURIUM, a genus of plants of the class Tetrandria, and order Monogynia. See Botany, p. 126.

CENTAURUS. See Astronomy, p. 734.

CENTER. See Bridge, p. 519, 529; Carpentry, and Framing.

CENTORBI, the *Centuripa* of the ancients, is a town of Sicily, situated on five points of rocks. It was formerly a populous and splendid town, but now exhibits only a mass of ruins. The large convent of the Augustins, the ruins of banks to the west of the town, and the remains of the castle of Conradin to the east, are the only objects of note. Numerous remains of antiquity have been found in this place, and are deposited in the museum of the Prince of Biscari, already mentioned in the article Catania. According to De Non, the soil in one part of the town consists of marine concretions, intermixed with shells. These concretions, along with tufa and a gritty stone, lie beneath the vegetable earth; and at a greater depth are found scoriæ and lava, beneath which is a fresh bed of grit. De Non supposes, that the lava forms the basis of the mountain; and that, from its being covered with marine concretions to the depth of 600 feet, the volcano from which it flowed must have been very ancient. Population about 3000. See De Non's *Journey in Sicily and Malta*, p. 85.

CENTRAL Forces. See Astronomy and Dynamics.

CENTRANTHERA, a genus of plants of the class Tetrandria, and order Monogynia. See Botanp, p. 125; and Brown's *Prodromus*, &c. p. 438.

CENTROLEPIS. See *Devauxia*, Botany *Index*.

CENTUNCULUS, a genus of plants of the class Tetrandria, and order Monogynia. See Botany, p. 113.

CEOS. See Zia.

CEPHÆLIS, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 144.

CEPHALANTHUS, a genus of plants of the class Tetrandria, and order Monogynia. See Botany, p. 113.

CEPHALONIA, an island in the Ionian sea, nearly of a circular figure, and about 120 or 130 miles in circumference, lying in 39 degrees of north latitude.

The climate of Cephalonia is temperate and agreeable, but subject to sudden changes, which are pernicious to the people. Copious rains commence in November, when thunder becomes frequent; but during the whole winter season, roses are in blow. Earthquakes are common, from which dreadful effects have ensued, particularly in 1736, 1742, 1753, and 1765, when entire towns were almost laid in ruins. Strong sulphureous exhalations rise from several places of the soil, which in some districts is rich and fertile, while others consist only of dry and barren rocks.

Large caverns are seen on the coast of singular appearance, the roofs being decorated by innumerable stalactites of fantastic shapes and various colours, and the bottom covered with petrifactions of shells. Mount Enos, now called the Black Mountain, consists solely of vertical strata, rising about 3000 feet above the level of the sea. Anciently it was covered with wood, but it is now entirely bare.

Among the different vegetables produced in Cephalonia, cotton and vines are the most valuable, as affording an essential supply for the uses of mankind. There is a kind of winter melon, which may be preserved a long time, if hung up, of an oval shape, and a beautiful yellow colour externally, with a white pulp. Medicinal plants are likewise found, which are said to have a wonderful effect in curing the gout; and various testimonies are produced in their favour. They were discovered by a physician named Zulatti, when resident in the island; and although few would at first acknowledge the virtue of his preparations, many in a short time afterwards gladly resorted to them. As the soil seemed peculiarly adapted to indigo, a plan respecting its culture was submitted to the Venetian government, by Signor Carburi, himself a native of Cephalonia, but who had emigrated from the island. The senate granted a large tract of land for the experiment, and created him a count, engaging to countenance the undertaking with peculiar favour. He speedily took possession, and having founded a small settlement, proceeded to form extensive plantations. Neither his skill nor conduct, however, seemed to promise that success which might have been reasonably expected; and, indeed, before the result of his different expedients could be known, he was cruelly assassinated. Olives are produced in great abundance, from which a quantity of oil is extracted sufficient to be an article of export: and much fine manna is produced in one of the forests, which might also prove valuable, but the collection of it has hitherto been neglected.

There are few quadrupeds or birds in Cephalonia, nor do many fishes frequent the shores. The principal indigenous quadrupeds are goats, whose milk is chiefly made into cheese, and a kind of carpets are manufactured of their hair; but the cattle and sheep consumed by the islanders, are brought from the Morea, 2000 head of the former being annually imported.

Though many portions of the soil are well adapted for agriculture, it is not assiduously followed, consequently the products of the island in grain are inconsiderable, not exceeding five months consumption. About 7,000,000 pounds of raisins are exported after home consumpt, and a small quantity of raw cotton. The wines made on the island are of agreeable flavour, and the inhabitants can spare about 15,000 casks, after supplying themselves. Some liqueurs, highly esteemed, are likewise made, which were, for the most part, presented to persons in power at Venice.

Cephalonia is the largest of the Ionian islands, yet the whole population does not exceed 70,000 souls, dispersed in three small towns, and about 130 villages or hamlets; nor does it appear to be receiving any accessions. Emigrations, on the contrary, are constantly taking place, though the Venetian government made great opposition to it.

Argostoli, the chief town of this island, stands at the foot of a hill, close to a bay of the same name, in an insalubrious and disagreeable situation. Its whole appearance exhibits incontestible evidence of the effect of earthquakes; and in addition to the ruins diffusely scattered, many buildings are advancing to rapid decay. Though the residence of the executive government, it is an inconsiderable place, containing a lazaretto and several convents. On the 11th of July, in the three successive years 1765, 1766, and 1767, an earthquake is said to have been felt almost exactly at the same hour, the last of which was particularly fatal to Argostoli.

Lixuri, the second town, also stands close to the sea, but in a more favourable situation, both for health and commerce. The same earthquake, however, so destructive to Argostoli, also ravaged Lixuri. It now presents a heap of ruins, and the streets are so much obstructed by them, that it requires some address in the passenger to find his way.

The fortress of Axo, which includes an inconsiderable town, was built by the Venetians in 1595, on a hill two leagues from Argostoli. The hill being lofty and precipitous, and accessible only by intricate paths, there is an irregularity in the fortifications, which, though it might serve as a retreat to the inhabitants, would preclude it from supporting a siege. Below there is a small harbour, which the earth and stones brought down from the hill by heavy rains are gradually choking up. The cathedral, which is small, and moderately decorated, stands here, and also a public building for the accommodation of the governor of the island.

When Cephalonia came under the dominion of the Venetians, it was erected into an archbishopric; but some of the prelates claiming undue prerogatives over the clergy of Zante, excited great dissensions in the church. These were terminated by a decree of the senate, ordaining the election of an ecclesiastic of the latter island, after two Cephalonians had successively occupied the archiepiscopal see. The election is conducted with great ceremony and formality, and formerly could not take place unless in presence of the governor-general of the islands, and different members of the state.

There are no less than twenty-five monasteries and nunneries on the island, one of which, a convent of Greek nuns, is situated on a hill near the fortress of Axo. Their church, in which they piously preserve the remains of St Erasmus, is the best endowed in Cephalonia. These relics, which they view with particular veneration, are contained in a large silver shrine, and exposed at festivals, or in times of public calamity.

Amidst such a redundance of religious houses, the education of youth seems to be cultivated in no public seminary. The natives, however, are not void of a desire to promote some points of knowledge, and in 1790 they founded an agricultural academy.

The only considerable manufactures in the island are of cotton cloths, (there called dimito,) and rossolis. Being dyed blue, the former serve for apparel to the Greeks, and from 160,000 to 170,000 yards are exported to the Venetian islands, the Morea, and Romelia. The latter is a strong liquor of agreeable flavour, prepared from odoriferous herbs abounding on the hills, but especially on Mount Enos. Somewhat more than half the value of the former is exported.

The Cephalonians are an active and intelligent race of people, temperate, and industrious; so that while the neighbouring islanders are either overwhelmed with indolence, or dissipating their wealth in luxurious or frivolous pursuits, they are providing stores for future necessities. A project once formed, is steadily maintained, in opposition to every resistance experienced, and the projector knows to adapt himself to all the circumstances which are likely to promise success. Emigrating from their native soil, the Cephalonians are frequently occupied during 20 or 30 years in seeking the means of independence, which they return to their island to enjoy. There hospitality is a leading characteristic; strangers are well received and entertained, and their presence is courted. The people, in general, are fond of society, and the women of the island enjoy unrestrained liberty. Nevertheless, to counterbalance the qualities thus ascribed to them, it is said that the men are intriguing and vindictive, that they are slow to pardon an aggressor, and the harmony of social intercourse is interrupted by the virulence of party dissensions in the towns.

Several celebrated persons owe their birth to Cephalonia. From modern history we learn, that in the latter part of the seventeenth century, a Cephalonian named Phaulkon was viceroy of the kingdom of Siam, and formed an intercourse between that country and Europe. Phaulkon, who was sprung from noble parentage, after first emigrating to England, repaired to India, and was at length employed as a factor at See-y-thaa, the capital of Siam. There he realized a considerable fortune, which he vested in commercial speculation, and embarked along with it on a voyage for another country. He was shipwrecked, however, along with a Siamese of rank, who saved nothing but his life, and who, in gratitude for Phaulkon carrying him home in a bark which he had purchased, affording him distinguished patronage, he soon rose to the highest offices in the state, protected the Jesuits who came from France, and sent a magnificent embassy to Louis XIV. During some years he enjoyed great prosperity, and always promoted a connection with Europeans; but endeavouring to persuade the king of Siam, who was childless, to adopt the son of a nobleman educated in the Christian religion, and being suspected of endeavouring to bring the whole kingdom eventually under French domination, a conspiracy was formed against him. He was seized by a powerful minister of state, and put to death with lingering torments in 1689. Cephalonia has likewise more recently produced able generals and mechanics. Of the latter, Count Carburi may be named, who accomplished the transportation of the rock to Petersburgh, which has received the statue of the emperor Peter, and by whom a detail of the whole procedure has been published.

While this island was under the power of the Venetian republic, it was governed by a nobleman sent from Venice, who, along with two counsellors, resided at Argostoli. The governor of the fortress of Axo was also a nobleman of the same city, but dependent on the former. The military commander was stationed at Lixuri, and the whole troops on the island did not exceed 300 men. The higher ranks of the inhabitants held a kind of senate, in which the nobles of Corfu were entitled to vote, as a reciprocal privilege was enjoyed by the Cephalonians at Corfu.

Cephalonia has now declined from that importance which many concurring circumstances prove it held in antiquity. Its cities, temples, fleets, and the enterprizes of its inhabitants, were all celebrated of old; and the contests for dominion over it, shew its consequence to neighbouring kingdoms. The ruins still existing on the surface, and the remains occasionally dug from the earth, testify that it was once more splendid and populous, and also that considerable progress had been attained in the arts. Four principal cities are mentioned by the ancients, all of which have long gone to decay, and the site of some can scarcely be recognised, though still known by analogous appellations. These were, Palis, Samos, Croni, and Pronus. The first stood about a mile from the port of Argostoli, in the most fertile part of the island, which is still called Palichi, and appears from the ruins to have been of considerable extent. Notwithstanding the ravages of time, the fragments occasionally discovered bear evidence of having been employed in elegant structures; thus corroborating the testimony of the ancient authors by whom they are described. About 30 years ago was found a tablet of Parian marble, bearing the following inscription in Greek: "By a decree, the senate and people of Palis have erected a statue in honour of the high priestess Flaviana Eutiches, the daughter of Pithodorus Glaucus, and spouse of Bion Aristomantides. It was merited by her chaste and exemplary life." The theatre at Elis, for the celebration of the Olympic games, was erected by the inhabitants of Palis.

Samos was in ruins in the time of Strabo, nearly 2000 years ago. Perhaps it was more extensive than the other towns, as the island, according to a passage in the Eneid, was called by that name. Gold and silver coins, sculptured fragments, and vases of bronze and marble, are yet recovered from among the ruins, which mark the site of the city as having been on the declivity of a hill. It has been affirmed, that an odour still sensibly issued from the latter when first opened, resembling the perfumes which were used by the ancients in their funereal rites.

The position of the other two towns can scarcely be recognised; but from the ruins dispersed through the island, it is not improbable that there were several besides. The uncle of Mark Antony, according to Strabo, being exiled here after his consulate with Cicero, founded a city, called Petulia, the progress of which was interrupted by his recal to Rome. Near Lixuri, a marble urn with a pedestal was lately found in a pit, which, from an inscription, seemed to contain the ashes of one of his friends who had perished by a violent death. Coins, portions of bronze tablets, and marble statues, were at the same time discovered. A temple on Mount Enos, consecrated to Jupiter, is mentioned in history as one of the most celebrated throughout Greece. (*c*)

CEPHALOPHORA, a genus of plants of the class Syngenesia, and order Polygamia Æqualis. See Botany, p. 290.

CEPHEUS. See Astronomy, vol. ii. p. 711.

CERASTIUM, a genus of plants of the class Decandria, and order Pentagynia. See Botany, p. 213.

CERATIOLA, a genus of plants of the class Diœcia, and order Monandria. See Botany, p. 327.

CERATOCARPUS, a genus of plants of the class Monœcia, and order Monandria. See Botany, p. 313.

CERATONIA, a genus of plants of the class Polygamia, and order Diœcia. See Botany, p. 341.

CERATOPETALUM, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 205.

CERATOPHYLLUM, a genus of plants of the class Monœcia, and order Polyandria. See Botany, p. 320.

CERATOSTEMA, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 216.

CERBERA, a genus of plants of the class Pentandria, and order Monogynia. See Botany, p. 135.

CERCIS, a genus of plants of the class Decandria, and order Monogynia. See Botany, p. 202.

CERES. See Astronomy, vol. ii. p. 599.

CERESIA, a genus of plants of the class Triandria, and order Digynia. See Botany, p. 109.

CERIGO, an island in the Mediterranean, celebrated in ancient history, from its capital Cythera dedicated to Venus.

This island, which is begirt with rocks and shoals, sometimes proving fatal to mariners, lies at the mouth of the Archipelago: it is of an oval figure, and about 50 or 60 miles in circumference. Near the coast are capacious grottos, the roofs of which are supported by pillars of stalactite, so regularly disposed, as at first sight to appear the work of art.

The climate, though temperate, is subject to sudden vicissitudes: shocks of earthquakes, generally slight and of short duration, are felt; and sometimes violent hurricanes, accompanied by scorching heat, waste the vegetation, and root up the trees.

The soil being rocky, the crops are not abundant; but a greater quantity of grain than is requisite for home consumption is obtained by the industry of the inhabitants, and its quality renders it an object of research by the neighbouring islanders. A certain kind of small onions, and olives also very small, produced here, are greatly esteemed, and reserved solely for presents. Such is likewise the case with two kinds of wine, one called *liatico*, which are too inconsiderable for exportation.

The only indigenous quadrupeds of Cerigo are hares and rabbits: but the inhabitants possess goats, and import a few cattle from the Morea. Many migratory birds, particularly quails, frequent the island; and fish are abundant on the coast, affording a constant and copious resource. But the Neapolitans, in prosecuting the coral fishery, avail themselves more of the latter; and the hazard of falling into the hands of pirates is besides a great restraint on the islanders. Scorpions of a large size are found here.

From the uncertainty of protection, the limited productions of the island, and the want of opportunities to ameliorate the condition of the inhabitants, the population is at present inconsiderable. It scarcely exceeds 8000 souls, dispersed in a town containing 1200, and in about thirty or forty villages and hamlets. Hernia is an extremely prevalent disease, insomuch that it is calculated a fifth part of the population labour under it. By some this has been judged an hereditary malady; according to others, it is owing to the great consumption of oil and legumes in diet; while the native physicians ascribe it entirely to the quality of the air.

Towards the south-west part of the island, the town of Cerigo, consisting of a confused assemblage of flat-roofed edifices, is situated on a hill. It is defended by a strong fortress, which was lately taken by the British, on the expulsion of the Turks and Russians. The houses are necessarily low, to resist the effect of earthquakes, and the frequent tempests. The capacious harbours described by the ancients no longer exist, nor is there more than a confined place for the anchorage of shipping at the base of the hill.

Several monasteries and convents are on the island, one of which is held in peculiar veneration, from the inhabitants believing that St John there composed the Revelations. It is cut out of the solid rock, amidst impending cliffs which threaten to crush the spectator. The Greek cathedral, where the bishop of Cerigo officiates on solemn occasions, was built at the expence of one of the eastern emperors in the year 1028.

An academy for the tuition of the public was recently established in Cerigo, and an old Roman Catholic monastery converted to the more useful purpose of accommodating the pupils.

As the political state of the island must, from necessity, be passive, the inhabitants have little inducement to action. They were deprived of the means of cultivation before the establishment of the academy; but some repaired to Italy for the benefit of education. Living in constant insecurity from the numerous corsairs which infest the shores of the Mediterranean, is a depressing restraint to the progress of improvement, and renders the property they possess of inferior value. Sometimes their shipping is destroyed, their cattle carried away, and their own persons exposed to imminent danger.

Most of the islanders devote themselves to agriculture, and the acquisition of articles of the first necessity: they besides carry on a trifling traffic with the neighbouring coasts.

Probably Cerigo was infinitely more populous of old, and has long been inhabited. Not far from the town is a hill, apparently composed of human bones alone, which, tradition says, was a cemetery in former times.

This island was known to the ancients by the name of Porphyrussa, supposed to be derived either from porphyry abounding in it, or from the shell producing a certain purple dye, held in high estimation in antiquity;

But it is not ascertained by the moderns that Cerigo has now to boast of either. It was also called Cythera; derived, as Ptolemy thinks, from Cytherus, the son of Phœnix, who established himself there. It is sufficiently authenticated, that the island was consecrated to the worship of Venus, under the name of Cythera; and when that goddess sprung from the waters, according to ancient mythology, she was wafted thither in a pearl shell. A temple was here erected in honour of her, the most celebrated within the bounds of the Grecian territories: it contained her statue, of unrivalled workmanship, with all her attributes; and also another, of Helen the queen of Menelaus. Ruins, conjectured to be those of temples or palaces, still exist; and some, more widely diffused, are supposed the vestiges of an ancient city, where Menelaus reigned. The islanders point out a grotto among them as the bath of Helen, cut out of the solid rock. Such ruins are dispersed over all Cerigo, both in the interior and on the coast; and in calm weather they are said to be discernible at the bottom of the sea. Coins and statues are sometimes dug up from the few decayed columns still remaining, which are said to mark the site of the temple of Venus; and an ancient quarry, of vast extent, shews that huge blocks were detached from it for constructing edifices. Catacombs, of regular shape and dimensions, with several sarcophagi, were lately discovered: the interior of the walls is plastered with a layer of pitch or mastic, whereon traces of painting could be recognised. (*c*)

CERIGOTTO, is a small island to the eastward of Cerigo, which was known to the ancients by the name of *Aigiala*. Its history has attracted little attention; but, from a medal still preserved, and belonging to very remote antiquity, it is supposed to have participated in some important naval events.

Cerigotto has, in modern times, been a constant receptacle for pirates from the continent, or other islands; and its own scanty population may be said to subsist almost entirely on plunder. It is composed of Greeks and Turks expelled from their native country; and, if the inhabitants find themselves in greater force than their visitors, they overpower them, and divide the spoil. Whenever a merchant vessel appears off their coast, which they think may prove a capture, they immediately arm their boats, and endeavour to cut her off. Some years ago, their depredations had become so obnoxious, that the Turkish government complained to that of Venice; and an order was, in consequence, issued to the governor general of the islands to extirpate the offenders. This, however, was never carried into execution. Though they acknowledge no laws or superiority but those of force, the inhabitants live in good understanding with the people of Cerigo, who entrust some flocks to pasture under their care on Cerigotto. Whatever the conduct of the inhabitants may have been to other nations, they treated a number of distressed Englishmen, whom casualties had directed to their island in 1807, with great humanity. At that time they dwelt in huts, gnerally built against the side of a rock, and containing one or two apartments on the same floor. The walls consisted of clay and straw, and the roof was supported by a tree in the centre of the dwelling. Their food was a coarse kind of bread, made of boiled pease and flour, and they had a scanty portion of kids' flesh. From corn they prepared a sort of strong liquor, which had an agreeable flavour. (*c*)

CERINTHE, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 127.

CERINTHIANS. See ECCLESIASTICAL HISTORY.

CEROPEGIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 15[illegible], 172; and R. Brown, *Wernerian Transactions*.

CEROXYLON, a genus of plants of the class Polygamia, and order Monœcia. See BOTANY, p. 337.

CERTIORARI, or CERTIORARI FACIAS, in the law of England, is a writ which issues out of the Court of Chancery or King's Bench, for the purpose of removing the records of a cause from an inferior to a superior court, into which the writ is returnable, in order that the party complaining may have the more speedy and effectual justice.

This writ is usually had, after indictment found, and before trial, to remove the indictment, with all the proceedings thereupon, from any inferior court of criminal jurisdiction, into the Court of King's Bench, which is the sovereign ordinary court in criminal causes. A *certiorari* is frequently issued for one or other of the following purposes. 1. To consider and determine the validity of appeals or indictments, and the proceedings thereupon; and to quash or confirm them accordingly. 2. The indictment is removed into the Court of King's Bench, or before the justices of *nisi prius*, when it is suspected that a partial or insufficient trial will be had in the court below. 3. In order to plead the king's pardon in the superior court. 4. To issue process of outlawry against the offender in those places where the process of the inferior judges will not reach him.

A *certiorari* lies in all judicial proceedings in which a writ of error does not lie; and the proceedings of all inferior jurisdictions, erected by act of parliament, are returnable in the King's Bench. When a writ of *certiorari* has been issued, and delivered to the inferior court, it supersedes the jurisdiction of that court, and renders all subsequent proceedings therein erroneous and illegal, unless the record be remanded to the court below by the King's Bench. The writ may be granted at the instance either of the prosecutor or the defendant; the former as a matter of right, the latter as a matter of discretion.

Indictments found by the grand jury against a peer are transmitted by *certiorari* into the Court of Parliament, or into that of the Lord High Steward of Great Britain. See Blackstone's *Comment*. b. iv. ch. 24.; and Jacob's *Law. Dict*. (*z*)

CERVANTES, MIGUEL DE SAAVEDRA, an eminent Spanish writer, author of Don Quixote, and one of the most distinguished satirists which modern times have produced.

It appears now to be ascertained, that he was born at Alcala in New Castile; though the place of his nativity has long been a matter of dispute, Madrid, Seville, and other cities, as well as Alcala, contending for that honour. The date of his birth is October 9th 1547. His parents were Rodrigo de Cervantes and Leonor de Cortinas, poor, but of honourable extraction. Whether he was related to Francisco Cervantes, author of a book, entitled, *Apologo de Ociosidad*, and published at Alcala in the year 1546, is, we believe, at present unknown.

According to the latest and best accounts, Cervantes received his education under an eminent teacher at Madrid. He was destined either for the church or the profession of medicine, but not relishing the methodical application which was required of him, he appears very speedily to have relinquished all severer studies, and betaken himself to the composition of verses. An elegy on the death of Queen Isabella, a poem, entitled *Filena*, and some sonnets, were his earliest productions. But they seem to have been published only to be neglected. Though rated high in the estimation of the author, they attracted little notice from the friends and patrons of literature. The great and the wise were too indolent or too busy, to attend, while he offered them consolation or amusement. This treatment appeared to Cervantes in the light of the most flagrant and criminal injustice. He considered himself as a young man cruelly dealt with, and resolved, in a paroxysm of resentment natural to a mind conscious of high powers, to bestow his labours no more on a public so ungrateful. Accordingly he quitted Spain, and withdrew himself to Rome. But his fortune was by no means ameliorated by the change; for he was reduced to such extreme distress, that he was constrained to enter into the service of the Cardinal Aquaviva, in the capacity of *valet de chambre*.

Such was the early condition of this man, for whose birth imperial cities have contended, and whom the world of letters now unites to honour. His miseries, however, did not stop here. He was quickly disgusted with the employment of the cardinal, and as he was wholly without friends, and seems to have had little concern or care of life, he enlisted as a soldier. In the latter capacity he served many years under Mark Antony Colonna; he was present at the battle of Lepanto, gained by Don John of Austria A. D. 1571: and history may record him as one instance at least, of a poet who fought valiantly in actual combat, and who, if compelled to retreat, did not expedite his flight by throwing away his shield. In the battle of Lepanto, he had his left hand struck off by the discharge of an arquebuse. The loss of his limb on this occasion he ever afterwards considered as highly honourable; regarding it, no doubt, as some proof of valour which had been subjected to trial, and found equal to its severity, or perhaps, as some evidence, that when his left hand was carried away, his right, which grasped his sword, was more actively employed.

In the year 1574, we find Cervantes a slave in Algiers. Here too his fortune was not a little diversified. His first master was Arnaute Marmi, the most ferocious as well as the most formidable of all the corsairs. From the rigorous bondage which he endured in the service of this barbarian, he oftener than once attempted to escape. He joined himself to 14 Spaniards, whom he had persuaded to leave the houses of their respective masters, and concealed himself, along with his companions, in a subterraneous abode not far from the shore. In the mean time, having procured the ransom of a prisoner, a native of Majorca, on whose fidelity he could depend, he dispatched this person to represent the case of the sufferers, and to implore that a small vessel might be sent, in order to convey them to their native country. The viceroy of Majorca was not inattentive to the request; a brigantine was immediately dispatched; but the coast of Algiers was so closely watched, that the vessel could not approach. And to complete the misfortunes of the captives, they were betrayed by one of their associates, seized in their retreat, and carried before the Dey, a ruler seldom known, even to his Mussulman subjects, by the exercise of mercy. From him therefore, Christians, and Christians who had endeavoured to escape from bondage, could not expect forgiveness. The prisoners approached the residence of the tyrant, anticipating death in its severest form. Fortunately, however, the event did not accord with their expectations. A pardon was offered them; but it was offered them on this singular condition, that they should instantly declare which of their number was the author and conductor of the enterprise. Here his companions hesitated, but Cervantes resolutely stepping forward, pronounced with a firm and audible voice, that the fatal but honourable distinction belonged to him, and added, in a tone equally firm and audible, that, in order to save his countrymen, he was ready to die. The barbarian ruler, struck with his intrepidity, refused to punish him; and even the savage Arnaute Marmi, whose property, according to the laws and customs of Algiers, Cervantes was, appeared unwilling that so brave a man should be put to an ignominious death. In four successive attempts to regain his liberty, the unhappy Spaniard completely failed. Still, however, after each attempt, his life was granted him; a fact the more difficult of explanation, as such mercy is rarely shewn within the dominions of Algiers. At length Cervantes was purchased from Arnaute Marmi by the Dey himself, and shut up in close confinement as his slave. But amidst all his misfortunes, the spirit of this extraordinary man continued unbroken and active. Under the eye of the court, and in the condition of a bondsman, he formed a project worthy of his enterprizing character,—a project no less hazardous than that of stirring up an insurrection among the subjects of Algiers, putting himself at their head, and dispossessing, by force of arms, the ruler of the country. This plot, likewise, was discovered before it was ripe for execution; but Cervantes, by what management or dexterity we know not, still escaped the punishment of unsuccessful rebellion. Whether the tyrant respected his bravery, and spared him on that account; whether he had the art to withdraw himself at a convenient season, foreseeing the failure of his scheme; or whether his condition was too humble to provoke the royal wrath, it is useless to enquire, because we have not the means of ascertaining the fact. If we may believe Cervantes himself, it was to the first or to the second of the causes just mentioned, that he was indebted for the forbearance which he experienced. In the novel of the *Captive*, the most interesting perhaps of any in Don Quixote, he refers to his own case when he says, "Only one Spanish soldier knew how to deal with him, (the sovereign of Algiers,) his name was Saavedra; who, though he had done many things which will not easily be forgotten by the Turks, yet all to gain his liberty, never received from his master either a blow or a harsh word; and yet we were always afraid, that even for the least of his pranks, he would get himself impaled; nay, he himself sometimes was afraid of it too. And if it were not taking up too much of your time, I could tell such passages of him, as would divert the company much better than the relation of my adventures, and cause more wonder in them." *Don Quixote*, vol. ii. p. 134.

That Cervantes, during his captivity, was regarded as a person of some distinction, is evident from the high ransom which was demanded for his release. Nothing less than 500 crowns of gold would satisfy the Dey his master; but on condition of obtaining that sum, with immediate dispatch, he signified his willingness to resign the prisoner. In these circumstances the parents of Cervantes sold what remained to them of possessions, in former times considerable, and aided by the benevolence of the Holy Fathers, who had it in charge from the king of Spain, to negotiate all matters respecting the liberation of captives, the stipulated ransom was paid. In the month of September 1580, the 500 crowns were put into the hands of the Dey, and Cervantes was restored to his country and his friends.

From this period we may date the commencement of his literary career. Disgusted with a military life, he appears now to have devoted himself with unusual ardour to the business and labour of writing. The taste of his age demanded pastoral poetry, and accordingly his first attempt was a pastoral, to which he gave the title of *Galatea*. Like other pastorals, it fails in this, that the incidents have little or no resemblance to those which occur in real life; and in the conduct of the piece, there is a very great extravagance of fancy, and absurdity of combination. The shepherds of Cervantes pronounce long orations on the topic of love, with arguments logically disposed, all intellectual, all orderly; and they talk, in an utter confusion of chronology, of Ixion, and Minos, and of Mark Antony; of Cæsar, Homer, and Hercules; of all the great captains of history, and all the heroes of romance. The events of the *Galatea* are by no means wholly of a pastoral nature. At the time when Cervantes wrote, the Spaniards were a brave and warlike people, the exploits of chivalry formed the basis of every tale; and among such a people, and in such an age, poetry, destitute of adventures and combats, was not likely to find many readers. The *Galatea*, therefore, is filled, not only with love, which belongs to the legitimate pastoral, but with battles, stratagems, and defiance. Mars and Venus preside alternately over the page, and duels and sonnets follow one another in discordant succession.

Notwithstanding these improprieties, however, the *Galatea* was favourably received. It was bought and read. And where a taste for romances has been acquired, it may still be perused with such pleasure as is to be derived from that species of writing. In consequence of his success, which was the more gratifying because it was unexpected, Cervantes appears about this time to have entered into the state of matrimony. His wife bears the name of Donna Catharina de Palacios; she was of a good family, but as she brought her husband no fortune, he was still obliged to depend, for his daily support, upon his literary exertions.

The next great work of Cervantes, was his famous *History of Don Quixote*. To the conception and execution of this work, the following incident is said to have given rise. Having occasion to travel into La Mancha, Cervantes unfortunately quarrelled with the inhabitants of a small village, named Argamazil, or, as some of his biographers have affirmed, contracted debts among them, and for the one or the other of these reasons, he was thrown into prison. While he remained in confinement, he wrote the first part of the adventures of Don Quixote, and in the height of his vengeance assigned to that redoubted personage, La Mancha, as his native province. But with a reserve, which may be accounted for in different ways, he abstained, throughout the work, from mentioning, or even alluding to the village where he had been so ignominiously, and, as he conceived, so unjustly treated. It is probable, however, that the circumstance above alluded to, is to be regarded only as the occasion which brought the great work of our author to light. The composition of such a piece must have been often in his thoughts. The plan, the incidents, and the texture of the performance, must have been matured in elaborate reflection: but it may, perhaps, be said, with truth, that had not the circumstance in question taken place, the plan, the incidents, and the whole work, might have remained for ever lost to the world, and buried in the breast which conceived them.

To enter into any lengthened criticism on the history of Don Quixote, would, in a work of this kind, be improper. We shall not, therefore, detain our readers with many observations. The hero of the performance is represented as a person of most amiable dispositions, and naturally of a sound understanding, but whose mind had become so far disordered by the incessant perusal of the old romances, as to mistake the fictions which they contained for sober and authentic history. In the workings of his imagination, he forms the design of assuming to himself the character of a knight-errant, and of sallying forth in quest of adventures. Every thing he meets brings to his recollection something which he had read in his favourite books. The slightest noise indicates an approaching rencounter; trees, and wind-mills, and flocks of sheep, are metamorphosed into giants; and whenever untoward or disastrous incidents occur, they are referred at once to the power of enchantment. Out of the reality of the appearances of nature, and occurrences of actual life, and the extravagant fancies and conduct of Don Quixote with respect to them, the ridicule arises. Attached to the hero, and in the capacity of his squire, appears Sancho Panza, who had left his family and his home, to take upon him the government of a kingdom which the knight had promised him, and whose simplicity and credulity, whose vulgar jokes and vulgar acuteness, add much to the humour of the piece. The effect of the whole is irresistible; the absurdity of knight-errantry, relatively at least to the time when Cervantes wrote, is represented in the most glaring colours; and, in point of fact, soon after the book was published, knight-errantry disappeared from among the nations of Europe.

After making these observations, it may be reckoned almost unnecessary to enquire, whether the satire of our author be directed against a proper object; whether the ridicule be well founded. Should the question be entertained at all, it might be answered, that chivalry and knight-errantry ought to be distinguished from the abuse to which, in common with every thing of a similar nature, they are undoubtedly liable. When the power of the feudal aristocracy was at its height, when every baron was the enemy of every other baron, and murders and rapine were frequent, the institutions of chivalry must be regarded as of the highest benefit. Though the neighbouring lord was his hereditary, and perhaps his implacable foe, yet the knight who had imbibed the true spirit of the character, disdained to attack or to injure him by dishonourable means. He was too valiant, and too confident in his valour, to have recourse to stratagem. He challenged his antagonist to combat in open day, either alone or attended by a specified number of followers. All the little arts of cunning men and of polished times were despised; and an elevation of soul, and an erect and open demeanour, were cultivated and acquired. As every man bore arms, and as the inferior persons attached to the great families were much addicted to plunder, the traveller could not pursue his path with safety, and the feeble were always at the mercy of the strong. Hence the true knight declared himself bound to protect the weak, and to succour the distressed; and hence bravery, open and witnessed, and compassion frequently exercised, gave the tone and aspect to this best period of the feudal times.

In the progress of society, however, the dominion of laws was gradually established; justice was obtained by other means than those of arms; and the blessings of peace came at length to be better known and duly estimated. It was no longer necessary that individuals should proclaim themselves the guardians of innocence and the protectors of the feeble: the law bore rule over the conduct of men, and the haughty baron himself was constrained to submit to its power. Chivalry, therefore, and knight-errantry, were no longer wanted; and to have continued the profession and the labours of knighthood, when the circumstances of society were changed, would have been to contrive the remedy after the disease had disappeared. Before Cervantes wrote, knighthood was become little more than a distinction; the young lord bore indeed the name or title, but was seldom or never required to discharge the duties which it formerly implied. The ancient building had for many years been decaying, some of its parts were already in ruins, and by the efforts of Cervantes, its last towers were shaken and fell to the ground.

When Cervantes was engaged in writing Don Quixote, he is said to have been under restraint from his fears of the Inquisition. In support of this assertion, there is an anecdote related in the second volume of the Curiosities of Literature. "M. du Boulay," says the author of that entertaining work, "accompanied the French ambassador to Spain, when Cervantes was yet alive. He has told me that the ambassador one day complimented Cervantes on the great reputation which he had acquired by his Don Quixote, and that Cervantes whispered in his ear, 'Had it not been for the Inquisition, I should have made my book much more entertaining." But if this was actually the case, it may be questioned whether the restraint alluded to was not, upon the whole, of a salutary nature; for had Cervantes felt himself at perfect liberty when writing his Don Quixote, we might perhaps have been disgusted with profanity and blasphemy in the perusal of that inimitable work.

Besides Don Quixote, Cervantes wrote also several novels and comedies, and a satirical poem, entitled, "*A Voyage to Parnassus.*" The novels have been read, but the comedies were not very favourably received. Perhaps the talents of our author were not fitted for dramatical writing, or perhaps the reputation of Cervantes was marred by the successful attempts of Lopez de Vega. And with regard to the satire, it had no other effect than that of procuring for its author very many and powerful enemies. The last work of Cervantes bears the title of, *The Troubles of Persiles and Sigismunda.* While employed in the composition of this work, he perceived the approaches of the disease which terminated his existence. He appears to have contemplated his dissolution with serenity, and even with gaiety; though an angry or perhaps a just critic would say, with a blameable hardihood or indifference. There is some proof of the insinuation now made, in the letter which he addressed to the Count de Lemos a short time before his death. And in his last performance, *The Troubles of Persiles and Sigismunda*, he mentions, that being on a journey to Toledo, a scholar, on learning who he was, sprung in rapture from his mule, and communicated to him a regimen for the dropsy, under which he laboured. But Cervantes declined complying with the advice, adding these words, not remarkable for their seriousness: "My life is drawing to a period; and by the daily journal of my purse, which I find will have finished its course by next Sunday at farthest, I shall also have finished my career; *so that you are come in the very nick of time to be acquainted with me.*"

See the Life of Cervantes prefixed to the Edition of Don Quixote, by the Spanish Academy; Life by Smollet; *Oeuvres de* Florian, vol. ii.; Aikin's *Biographical Dictionary, article* Cervantes; and *Curiosities of Literature*, vol. ii. See also BUTLER, Samuel. (*h*)

CERVANTESIA, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 171.

CERVUS. See MAMMALIA, *Index.*

CESSAVIT, in the law of England, is a writ which lies, by the statutes of Glocester, 6 Edw. I. c. 4. and of Westm. 2. 13 Edw. I. c. 21. and 41. against the tenant of a lord by rent or other services, on the ground that he hath, for two years together, neglected to perform his services, or to pay his rent, in terms of his tenure; or against a religious house, having lands given it on condition of performing certain spiritual service, which it neglects. In either of these cases, if the *cesser*, or neglect, have continued for two years, the lord or donor, and his heirs, shall have a writ of *cessavit* to recover the land itself, *eo quod tenens in faciendis servitiis per biennium jam cessavit.*

By the statute of Glocester, the *cessavit* does not lie for lands let upon fee-farm rents, unless they have lain fresh and uncultivated for two years, and there be no sufficient distress upon the premises; or unless the tenant hath so inclosed the land that the lord cannot come upon it to distrein. And if the tenant come into court before judgment, and tender the arrears and damages, and give security for the future performance of his services, the process shall be at an end, and the tenant shall retain the land. If the lord distreins while the writ of *cessavit* is depending against his tenant, the writ shall abate. Blackst. *Comment.* b. iii. ch. 15. Jacob's *Law Dict.* (*z*)

CESSIO BONORUM, in the civil and Scots law, is a process whereby persons who have become insolvent, by misfortune, may obtain their liberation from imprisonment, upon surrendering their whole estate, real and personal, to their creditors.

During the period of the Roman republic, the laws against insolvent persons were exceedingly severe; indeed, so hardly were they dealt with, that they were left almost entirely to the mercy of their creditors. By a law of the twelve tables, it had been enacted, that debtors, if they were not solvent within a specified time, should be delivered over to their creditors, to be kept in chains, and subjected to the harshest treatment. (Aul. Gell. *Noct. Att.* xx. 1.) This law produced great discontent among the people, which necessarily occasioned the introduction of the *Lex Poetelia*, by which it was enacted, that the persons of debtors should not be given up to the creditors, but only their effects. As this law, however, provided no means of liberation from imprisonment, and the people were still clamorous for some new enactment on the subject, the *cessio bonorum* was at length introduced by Julius Cæsar, which, at first, was only intended for the benefit of Rome and Italy, but was afterwards, before the time of Dioclesian, extended to the provinces. The provisions of this remedy are expressed in the following law of the code: *Qui bonis cesserint, nisi solidum creditor receperit, non sunt liberati. In eo enim tantummodo hoc beneficium eis prodest, ne judicati detrahantur in carcerem.* L. i. Cod. *Qui bonis cedere possunt.* See also *Digest.* lib. xlii. tit. 3. This law was adopted, in substance, by those among the modern European states, whose systems of jurisprudence were formed upon the model of the Roman code.

It would appear, however, that a certain degree of infamy was always attached to those who had recourse to this process. The Italian lawyers describe the ceremony of cession to consist in striking the bare breech three times against a stone, called *lapis vituperii*, in the presence of the judge. Formerly it consisted partly in giving up the girdles and keys in court; as the ancients used to carry at their girdles the chief utensils wherewith they got their living. The following is said to have been the form of cession among the ancient Romans and Gauls: the cessionary gathered up dust in his left hand, from the four corners of the house, and standing on the threshold, holding the door-post in his right hand, threw the dust back over his shoulders; then stripping to his shirt, and quitting his girdle and bags, he leapt with a pole over a hedge; hereby giving the world to understand that he had nothing left, and that when he jumped, all that he possessed was in the air along with him.

In modern France, every debtor who claimed the privilege of a judicial *cession des biens*, was required to appear personally in court, in the most humiliating garb, with his doublet unbraced, and no hat on his head. Afterwards he was carried to the market-place, where the *cessio* was published. Even the most innocent was compelled to wear a green bonnet, which was his sole protection against imprisonment. In course of time, however, the green bonnet fell into disuse in the case of innocent debtors.

By the law of Scotland, the process of *cessio bonorum* is competent only before the supreme court; and the privilege is granted only to those against whom no fraud can be proved. The debtor must have been a month in prison, at the time of bringing his process. The *cessio*, both by the civil and Scots law, operates only as a security against imprisonment, and not as an extinction of the debt; for if the debtor acquire any estate, subsequently to his release, it may be attached by his creditors.—Persons liberated on a *cessio bonorum*, are obliged to wear a particular dress, called the *dyvours habit*, unless the court dispense with this mark of ignominy, which they generally do. See Heineccins *ad Pandect*, lib. xlii. tit. 3; Erskine's *Inst. of the Law of Scotland*, book iv. tit. 3. § 26, 27.; Bell's *Comment. on the Bankr. Law*, book v. ch. 5. (*z*)

CESSION, in a legal sense, signifies an act whereby a person surrenders up, and transmits to another, a right which belonged to himself.

In the ecclesiastical law, *cession* denotes the voiding of one benefice by taking another. For, by statute 21 Hen. VIII., if any one, having a benefice of 8*l. per annum*, or upwards, according to the present valuation in the king's books, accepts of any other, without dispensation, the first shall be adjudged void by cession. When an incumbent is made a bishop, all the benefices he before held become void by consecration, unless he obtain a dispensation. When a benefice becomes void by consecration, the king is entitled to present, for that time, whoever happens to be patron: in the case of voidance by cession, the patron may present. (*z*)

CESTRUM, a genus of plants of the class Pentandria, and order Monogynia. See BOTANY, p. 137.

CESTUS. See the article ATHLETÆ.

CETOLOGY.

THE animals called *Cetacea*, or Cetaceous Animals, constitute the last order of the class MAMMALIA, or mammiferous animals, in most of the modern systems of Zoology; especially in those of Linné, Blumenbach, and Cuvier; while, in the writings of the older naturalists, they have been regarded as an order of fishes. A more attentive examination of their intimate structure has, however, proved the impropriety of both these arrangements; and seems to point out the necessity of forming these animals into a distinct and independent class.

They resemble fishes in almost nothing but their *habitation;* while they are distinguished from those animals by the structure of their *atlantal* or anterior extremities; by the form and position of their tail; by their mode of breathing; and by producing their young alive, and suckling them by teats. On the other hand, while they possess the respiratory and generative organs of quadrupeds, they are essentially discriminated from these by the form of their bodies; by their total want of *sacral* extremities, or hind feet; by the peculiar structure of their tail; and by that characteristic mechanism attached to their organs of respiration, which gives them the power of ejecting through appropriate outlets the water received into their mouths while swimming, or seizing their prey.

CETOLOGY, then, is that department of ZOOLOGY, which treats of the structure, economy, and history, of cetaceous animals, or of *whales*, and other inhabitants of the deep, which resemble these in anatomical structure.

As few of these animals appear to have been known to the ancients, we meet with but little respecting them in the writings of the first naturalists. Both Aristotle and Pliny, however, mention several of those species with which we are now most intimately acquainted. Thus, the former, in his *Historia Animalium*, lib. iii. cap. 12. speaks of the great or *Greenland whale*, under the name Μυστικητος, while, in the twelfth chapter of his sixth book, he treats of the *Dolphin*, Δελφις, and the *Porpesse*, φωκαινα. Though this writer gives us but an imperfect account of all those species, and mixes a good deal of the marvellous with his descriptions, he is much more to be relied on than any of his successors of the ancient school. In particular, his natural history of the dolphin is the most faithful of any that we find in ancient writers, and proves, that Aristotle, either from his own observation, or that of his assistants, was well acquainted with the true form and manners of the animal which he describes.

The *Natural History* of the Elder Pliny abounds in observations on several species of whales, especially the *great whale*, which he describes in the 37th chapter of his eleventh book, under the name of *Musculus;* the *Dolphin* (*Delphinus*), lib. ix. cap. 9.; the *Porpesse* (*Tursio*), in the 8th ch.; and the *Grampus* (*Orca*), in the 6th chap. of the same book. We are by no means certain, however, that modern writers are correct in assigning the *Musculus* of Pliny as a synonime of the *Mysticete*, or great whale; for he speaks of the former as preceding another species, which he calls *Balæna*, by way of leader; and, in several parts of his work, he denominates the largest species of whale *Cete.* The descriptions and relations of Pliny, respecting these animals, are exceedingly fanciful, and show that disposition towards the marvellous for which this naturalist is so celebrated. His account of the dolphin, in particular, is little better than a collection of fables, gleaned from the poets and travellers of the time; but, on the other hand, his account of the grampus, and the contests between this species and the large whales, is very respectable, and tolerably authentic.

Among the earlier naturalists of modern times, many have treated, more or less minutely, of cetaceous animals, as Aldrovandi, in that part of his general work entitled *Ceta;* Gesner, in his work *De Piscibus;* Johnston, in his *Historia Naturalis De Piscibus et Cetis;* and Rondelet, in his *Histoire des Poissons.* Of these, the most respectable is Rondelet, whose work is still quoted with approbation by most succeeding writers. He does not, however, add much to our stock of information respecting the number of species, though he mentions some, especially the *Gibbar*, not known to the older naturalists. The work of Aldrovandi is perhaps the most imperfect and inaccurate of the four. He quotes largely, and apparently with implicit credit, from the writings of Aristotle and Pliny, and even from the fictions of the poets.

Among the naturalists of the 17th century, we may mention three of our countrymen of distinguished eminence in most branches of the science,—Willughby, Ray, and Sibbald. Mr Willughby's work, *De Historia Piscium*, edited by his friend Ray, contains many valuable remarks on cetaceous animals, especially on the *great whale*, the *dolphin*, the *porpesse*, and the *grampus.* This learned writer was one of the first to mark distinctly, the similarity of anatomical structure in whales and quadrupeds.

Ray, in his *Synopsis Piscium*, follows his predecessors in natural history, in the error of including *cetacea* among fishes, though he seems to be among the first that have doubted of its propriety. His reasons for this arrangement, from which we infer his hesitation, are, that the form of their bodies agrees with that of fish; that they are entirely naked, or covered only with a smooth skin; and that they live entirely in the water, and have all the actions of fish. Now, in this last circumstance, our distinguished naturalist is mistaken; and, as he found their mode of respiration formed to his arrangement an objection not easily to be overcome, he divides fishes into those that breathe by lungs (*pulmone respirantes*,) and those that breathe by gills (*branchiis respirantes*); thus establishing the former of these sections, for the purpose of including the cetaceous animals. The number of species enumerated by Ray is considerable, and he has noticed almost all those which have occasionally been thrown on the coasts of our islands.

The first work of any distinguished eminence as a separate treatise on cetaceous animals, is the *Phalainologia Nova* of Sir Robert Sibbald, first published at Edinburgh in 1692, and reprinted in London so lately as 1773. In this work, the writer professes to describe the rarer species of whales that had been cast on the shores of Scotland, distinguishing them according to their natural characters into genera and species, and adding some observations on the nature, origin, and use of spermaceti and ambergris. Considering the time at which this was written, it is a valuable work, containing accurate descriptions, and, in general, judicious remarks. It first treats of whales in general, then distinguishes these into such as have teeth in both jaws, such as have teeth only in the lower jaw, and such as want teeth altogether, the proper *Balænæ.* He particularly describes the *grampus*; the *small spermaceti whale*, or round-headed cachalot; the *black-headed spermaceti whale*, or great-headed cachalot; the *high finned cachalot* of Pennant; the common or *Greenland whale;* the *pike-headed whale;* and the *round-lipped whale.*

As far as Sir Robert depends on his own observations, we believe he is in general perfectly correct; and his work must be considered as one of the best treatises on cetology, and far superior to any thing that appeared on the subject for nearly 100 years afterwards.

Early in the 18th century, Artedi, the friend and companion of Linné, composed his *Synopsis Piscium*, into which he has introduced the cetaceous animals as an order of fishes, and where he has distinguished a greater number of species than had been enumerated before. His specific characters are, in general, highly expressive, and very accurate, though, in describing the *grampus* as having broad serrated teeth, (*dentibus latis serratis*,) a mistake into which Linné has also fallen, he seems to have copied the erroneous account of Rondelet.

Among the last writers who have considered the *cetacea* as an order of fishes, is Mr Pennant, who in the third volume of his *British Zoology*, describes twelve species of these animals as his first division of fishes, under the title of *cetaceous fish.* His principal reason for this arrangement is, that in this way we preserve entire the chain of beings, since as the *seals* and *manati* resemble quadrupeds in the structure of their fore feet, and fishes in the structure of their tail, so cetaceous animals resemble the *manati* in the former circumstance, and, still more than they, resemble fishes in the form of their body, and structure of their tail. Pennant has borrowed much of his information from Sir Robert Sibbald's work, and has also gleaned freely both from the ancients, and from some modern histories and voyages, as Dale's *Account of Harwich;* Marten's *History of Spitzbergen;* Crantz's *Greenland;* and Borlase's *Account of Cornwall.* In one instance, the *blunt-headed cachalot*, he seems to have described entirely from his own observation, and has given a figure of the animal and its teeth.

The most complete and scientific work on cetology, is undoubtedly the *Histoire Naturelle des Cetacés* of La Cépéde, published at Paris in 4to in the year 1804, (12th year of the republic.) John Hunter had given the best account of the anatomy and physiology of these animals, in the 77th volume of the *Philosophical Transactions*; and Bonnaterre had described, in a masterly manner, their natural history, in that department of the *Encyclopedie Methodique* allotted to CETOLOGY; but it was reserved for La Cépéde to bring together every thing valuable that had been written on the subject; to reduce it to form and method; and improve the whole by systematic arrangement, and animated description. He has distributed the thirty-four species (or varieties) of *cetacea* which he describes, into two orders, the *toothless* and the *tooth-*

ed. Of the former, he makes two tribes and eight species; of the latter, eight tribes and twenty-six species. His division of the *genera*, of which we shall say more presently, is certainly more accurate and scientific than that of any of his predecessors, inasmuch as it is founded on anatomical differences; and though his generic and specific characters are often unnecessarily long, and involve circumstances that are implied in the preceding characters of the *order*, or the *genus*, they are more accurate and more descriptive than those of any other author with whom we are acquainted.

These are the principal writers on zoology who have treated on cetaceous animals; but there are several works on the productions of particular countries, which contain useful or curious information on the same subject. Of these, we shall notice a few of the most respectable, and thus conclude our historical sketch of cetological writers.

Among the earliest of these is the *History of Iceland*, drawn up by John Anderson, a German naturalist of considerable reputation. He has described several species that were little known before his time, particularly the *nordcaper*, or Iceland whale, the *knobbe fish*, or scrag whale, and the *Jupiter fish*, or pike-headed whale: and he has interspersed some amusing particulars respecting their manners, and the methods employed by the Icelanders in taking them, though these latter cannot always be received with implicit credit.

Frederic Martens, another German, published an account of *Spitzbergen* and the neighbouring arctic regions, which is frequently referred to by Pennant and other zoological writers, particularly as containing the best account of the *gibbar*, or, fin-fish, and the *butskopf*, or beaked whale.

About the middle of the eighteenth century, John Egede, a Danish missionary, who had passed many years in Greenland, successfully labouring for the conversion of the natives, and who had acquired a thorough acquaintance with the productions of the country, and the manners of the inhabitants, published his *Description of Greenland*, which was speedily translated into English, and published in 8vo, with tolerable plates, in 1743. This work contains an account of the *black* or Greenland whale, the *fin fish*, and the narwhal, or *unicorn fish*, which, though not very particular, is more to be relied on than that of his predecessors.

The *History of Greenland*, in two volumes, published in German by David Crantz, a missionary of the United Brethren, in 1765, and translated into English in 1767, gives the best account of the natural history of those frozen regions. This account is confined chiefly to the first volume, which contains descriptions of 15 species of cetaceous animals. Only two of these, however, the *white fish* and the *porpesse*, are described from the author's own observations; the account of the rest being copied from Marten's *Spitzbergen*, Anderson's *Iceland*, and similar works of established reputation.

In 1751, Erich Pontoppidan, bishop of Bergen, published, in the Danish language, his *Natural History of Norway*, of which an English translation appeared at London in 1755. The second part of this work is devoted chiefly to zoology, and contains many particulars respecting some of the cetacea, as the *hual fish*, or great whale, the *nebbe-hual*, or beaked whale, the *narwhal*, or sea unicorn, and the *marsvin*, or porpesse. His account of the great whale is very minute, and tolerably accurate, though, like most of the good bishop's relations, it sometimes savours too much of the marvellous to be received without limitations. His description of a bladder beneath the back bone, by means of which the whale renders himself more or less buoyant; and his account of the "terrible roar" sent forth by this animal when bitten by the *speckhuggeren*, (gladiators.) or when ready to burst from repletion after a full meal of herrings, are erroneous. His figures are worse than his descriptions; for by way of representing the Greenland whale, he gives a bad figure of the cachalot, and his figure of the narwhal has the *body* spirally twisted as well as the *horn*.

Among the British *Faunæ*, we may particularly notice Dale's *History of Harwich*, Borlase's *History of Cornwall*, with two works of our contemporaries, Neill's *Tour to the Orkney and Shetland Islands*, and Fleming's *Natural History of the Zetland Islands*. The former of these two last works contains the distinguishing marks of a species or variety of the dolphin tribe, called by the Scottish islanders the *ca'ing whale*, and the latter notices the several species of cetaceous animals that have appeared on the shores of Zetland. Mr Fleming has also given an excellent account of a species of narwhal in the *Memoirs of the Wernerian Natural History Society* of Edinburgh.

In the account which we are here to give of cetaceous animals, we shall first describe their general structure and economy, and shall afterwards give a comprehensive view of each tribe, and of the more important species, distinguishing whatever is most remarkable in what is called their natural history, including their form, size, proportions, and colour; the particular situations where they are most generally found; their manners and way of life; the enemies to which they are most frequently exposed; and the uses to which their spoils have been applied by their most powerful enemy, man.

PART I. ANATOMY AND PHYSIOLOGY OF CETACEOUS ANIMALS.

In their general form, these animals nearly resemble the ordinary tribes of fishes, and like these, are enabled, by their conformation, to move through the water with great velocity. In most species the head is conical, and more or less pointed at the snout; though the *great spermaceti whale*, and some others of the *physeter* genus, are an exception to this general rule. In most of them the head is extremely large, in proportion to the body, and swells out at the sides towards the insertion of the lower jaw. The head is joined to the body by a neck, so short, as to be scarcely perceptible. There is no appearance of external ear, but only a small orifice, leading to the internal organ of hearing. The eyes are, in general, extremely small, in proportion to the size of the animal, and are commonly situated very far back, near the articulation of the lower jaw. There is always one hole, and in some species two holes, opening in some part of the top of the head, and serving less for nostrils than for ejecting the water taken in by the animal's mouth.

The body is more or less conical or cylindrical, entirely without hair, and covered with a thick and dense cuticle. At the posterior or *sacral* extremity, the body terminates in a forked tail, that is flattened horizontally, and is very strong and muscular. In some species there is a fin, in others a protuberance, on the top of the back, and all of them have two members, one on each side of the chest, which are usually denominated *pectoral fins*, but are better entitled to the name of *swimming paws*, as they nearly resemble the *atlantal* extremities, or fore feet of seals and walrusses. These animals have evident external organs of reproduction, and in the males especially these are sometimes very large and prominent.

SECT. I. *Motion.*

The motive organs of cetaceous animals have many striking peculiarities. The skeleton has its parts joined together in such a manner, and is so deeply imbedded within the fat and muscles, that it does not, as in quadrupeds, much influence or discriminate the external form of the animal. The bones have a very loose and coarse texture, so that the fibres are readily distinguished, even on a superficial view; and in some, as the jaw and ribs, easily loosened, and rendered extremely obvious by maceration. None of the bones have any medullary cavity. Though the neck in these animals appears extremely short externally, that part of the skeleton is composed of the same number of bones as in quadrupeds, namely seven; though in some of them, as the *dolphin* and *porpesse*, the two next the head, and in others, as the several species of *physeter*, the six last, or *sacral vertebræ*, are united or anchylosed. Thus in the two former species, there can be no rotatory motion between the head and neck; and in the *physeter* tribe, the motions of the head must be exceedingly obscure. The number of joints composing the back differs considerably in these animals. Some, as the *dolphin* and *porpesse*, have thirteen; others, as the *piked-whale*, only twelve. The number of ribs also varies, depending on that of the dorsal *vertebræ*. In some species Mr John Hunter distinguished eighteen ribs on each side; while in some spermaceti whales, thrown ashore on the coast of France, there were only eight ribs on a side.

There is no *pelvis* in the skeleton of these animals, and it is therefore impossible to distinguish the lumbar *vertebræ* from those of the *coccyx* or tail. In many species, these sacral or posterior *vertebræ* are very numerous. Thus, in the *dolphin* and *porpesse*, they exceed fifty. The most remarkable part of the skeleton of cetaceous animals is, the atlantal extremities or *swimming paws*, whose bones in number and articulation nearly resemble those of man. We can clearly distinguish a *scapula* or blade bone, an *humerus* or shoulder-bone, two bones similar to those of the fore-arm, and a hand consisting of five fingers. All these bones are, however, much flattened, and susceptible of but little motion on each other; though they are so connected by means of cartilage, that the whole number possesses considerable pliability and power of general motion.

The flesh which covers the skeleton is of a red colour, and nearly resembles that of the *horse* and *cow*. It is in general hard, firm, dry, and tendinous. The muscles of these animals soon lose their fibrous texture after death, speedily running into putrefaction; though this change is apparent, more from the change of texture, than from the disagreeable odour which the flesh exhales. The most remarkable part of the muscular system is that which gives motion to the tail. This organ is composed of two oval lobes, formed of three layers of tendinous fibres, of which the two external or *peripheral* layers have a direction similar to that of the lobes, and are crossed by those of the internal or *central* layers. By means of this structure, the tail in these animals is susceptible of very extensive and rapid motion, and not only serves the purpose of a fin, to impel the animal forwards, but furnishes him with a most formidable and effectual offensive weapon. Indeed the force of the tail, in the larger species, where it sometimes measures above 20 feet from the tip of one lobe to that of the other, is so great, that a single stroke with it, well aimed, is sufficient to cut a boat in two, or sink it to the bottom.

When we consider the enormous bulk of some species of whales, we shall be surprised at the celerity with which they make way through the water. It is computed by the French naturalists, that some of them are capable of rushing through 33 feet in a second of time, and that, supposing them to move with a uniform and uninterrupted motion, 23 days would be sufficient for enabling them to circumnavigate the globe.

SECT. II. *Of Sensation.*

The brain in these animals has pretty much the same structure as that of quadrupeds, though in most of the species it is very small in proportion to the size of the animal, and especially that of the head. It is proportionally largest in the *porpesse*, and smallest in the *great spermaceti whale*. Its substance is compact, and more visibly fibrous than perhaps in any other animal. The distinction between *cortical* and *medullary* matter is well marked, and of these the latter is very white. The lateral ventricles and *thalami* of the optic nerves are large; the *corpora striata*, small. The *medulla oblongata* is in general extremely small, when compared with the rest of the *encephalon*, especially in the *dolphin*, where the latter is to the former as 15 to 1. The spinal marrow is comparatively small, though in some species, as the *large spermaceti whale*, it is proportionally very large. In structure it agrees with that of quadrupeds.

The nerves of CETACEA differ little from those of other MAMMALIA, except that the *olfactory* nerves are wanting, and their office seems to be supplied by the first branch of the *fifth* pair.

It is probable that these animals possess none of the external senses in any exquisite degree, except that of *sight*. In many, it would seem as if the sense of *smelling* were entirely wanting; and by reason of their defect in external auditory organs, their *hearing* cannot be acute.

It does not appear that these animals possess any particular organ of *feeling*; for though the swimming paws are composed of a great number of separate bones, these are neither so delicate, nor so moveable, as to enable the animal to employ those members in the way of fingers, though they are often used as a hand or arm to support and protect their young. It is in the skin, therefore, that covers the general surface of the body, that the sense of touch of which these animals are capable seems to reside; and from the numerous *papillæ* which cover the whole peripheral surface of the skin, it is probable that they possess the sense of feeling, in no small degree, especially considering the element in which they live.

From the size, softness, and humidity of the *tongue* in these animals, we may suppose that they are by no means defective in *tasting*, though this is a point that must rest entirely on conjecture. The organs that appear subservient to this and the former sense, as they are certainly better adapted for other purposes in the economy of these animals, will be considered more at large in future sections.

Though there be no distinguishable organ of *smelling* in the CETACEA, it is thought by some naturalists, that the sense of smelling is by no means wanting in these animals; and this seems to be confirmed by an anecdote related by La Cépède.

It appears pretty certain that these animals perceive *sounds*, even though weak, at a considerable distance. The internal structure of their organs of *hearing* is by no means ill calculated for receiving impressions from the vibrations of the atmosphere. They have a very large auditory canal, and a eustachian tube of great diameter. Besides these, most species possess a *labyrinth* with three *semicircular canals*, a *cochlea*, a *vestibule*, and *a tympanum* lined with a membrane, and provided with little *bones* articulated together. The *eustachian tube* communicates internally by the *tympanum* with the mouth, and ascends upwards towards the top of the spout-holes, into the cavity of which it opens; and that part of it which is next the internal ear, exhibits, on its inner surface, a pretty large hole, or empty depression. Both the tube and its cavities are lined with a blackish delicate mucous membrane. It is supposed by some, that this organ assists the animal in receiving impressions from odorous bodies. All the bony parts of the internal ear are exceedingly hard.

The element in which these animals reside is well calculated for communicating sonorous vibrations, and it is probable that when they remain in their usual position, with the head, or at least the external auditory orifices, several feet below the surface of the water, their hearing is much more acute than when the head is elevated into the air.

The most perfect sensitive organ in cetaceous animals, is undoubtedly the *eye ;* for though this organ is, in some species, extremely small in proportion to the bulk of the animal, that of the largest whale scarcely exceeding in diameter the eye of a bull, yet its conformation is as perfect as that of quadrupeds, while it possesses, in common with that of fishes, a peculiarity of structure, for the greater refraction of the rays of light.

We have already remarked (see ANATOMY, Part II. vol. ii.) the unusual thickness and closely interwoven fibres of the sclerotic coat of the eye in these animals, and their want of lachrymal glands or ducts. We may add, that the union between the sclerotic coat and the *cornea* is much closer than in quadrupeds, consisting of long and very delicate filaments, that penetrate the substance of each membrane, and fasten them together; that the fibrous and vascular structure of the choroid coat is extremely evident; and that the crystalline lens, like that of fishes, is nearly spherical.

SECT. III. *Digestion.*

THE digestive organs of cetaceous animals differ very considerably, according to the food on which they live, and their manner of seizing it. Those of *mastication*, in particular, are so various, as to constitute the principal differences that discriminate the orders and *genera*.

The general form of the mouth is very different in different species. In some, as the *dolphin*, and most of its congeners, it is long, narrow, and shallow; while in others, as the proper *whales* and *cachalots*, it is nearly of an oval form, and often extremely broad and deep. The opening of the jaws in the *balænæ* and the *cachalots* is exceedingly wide, so as, in some of the former, to admit of several men entering erect the open mouth, and standing upright within the cavity.

The form and proportions of the *jaws* are very various. In some, they are nearly of the same length; while in others, the lower jaw extends beyond the upper, or lies within it as in a groove. Sometimes the snout, formed by the anterior extremity of the jaws, is pointed; but in most cases it is more or less round and obtuse.

In those CETACEA that have many teeth in both jaws, the teeth are so situated, as, when the jaws are close, to lock into each other. They are most numerous in the *dolphin*, in which some naturalists have reckoned above 180, while others saw only about 40 in both jaws,—a difference which probably depends on the age of the animal. They are almost always cylindrical, or rather conical. Mr Hunter describes them as composed of a double cone, one part of which extends beyond the gum, while the other constitutes the fang by which they are inserted in the jaw. In some species, as the dolphins, they are straight, and more or less pointed; in others, as the cachalots, they are usually curved and obtuse.

The formation and progress of the teeth, in these animals, appear to differ from those of quadrupeds. They seem to be formed within the gum, and either to sink thence into the sockets, or remain fixed till these latter rise to inclose them. As in other animals, the number of the teeth seems to increase as the jaws advance in length, though Mr Hunter is of opinion, that they do not, like quadrupeds, shed their teeth. *Phil. Trans.* vol. lxxvii. p. 399.

Most naturalists describe the body projecting from the upper jaw of the *narwhal* as a *tooth*, though it appears to us to have very little analogy to these organs, and certainly does not assist in the process of mastication. It is clearly a *horn* or *tusk*, similar to those of the elephant and other quadrupeds, and is calculated to serve the purposes of an offensive and a defensive weapon.

The *balænæ*, instead of teeth, have a curious apparatus, consisting of horny plates, with fringed or hairy borders hanging from the edge of the upper jaw. The description given of this substance by different naturalists varies in several respects; but the most accurate account appears to be that of Cuvier, which is as follows:—

The maxillary and palatine bones, in this tribe. form on their inferior surface two inclined planes, which give to the palate the appearance of the roof of a house reversed, and their two surfaces are concave. It is to those that the laminæ of the whale-bone are attached: these are all parallel to each other, and have a transverse direction with respect to the axis of the body. Several hundred of laminæ may be counted on each side, and in the Greenland whale they often exceed 10 feet in length. They are fixed to the bone by a kind of fleshy or ligamentous substance. Each lamina presents, on its internal side, a layer of horny fibres, growing from the horny plates, but less fine, and more divided than the plates from which they proceed. These fibres extend between the plates, and form a fringe or loose border on the lower part of the plates, so that these fringes hang down from every part of the palate, which is above the tongue, and entirely invest this organ. The use of this horny substance, or whalebone, seems to be to retain, as with a net, those small animals which the whales seize and swallow for food. *Anat. Compar.* tom. 3. p. 199.

The above description differs in several respects from that of Mr John Hunter, in the *Philosophical Transactions* for 1787, and from that given by Mr W. Scoresby, in the first volume of the *Memoirs of the Wernerian Natural History Society*. According to the description of the latter writer, the longest blades of whalebone are nearer the throat than the snout, and they become gradually shorter before and behind this point. They are curved in two directions, both longitudinally from the sides to the centre of the mouth, and transversely. The whalebone is covered below by the under or basilar lips, which, when the mouth is shut, overlap the upper part in a squamous manner.

The plates of *whalebone* are of a black colour, mottled with shades of a lighter hue ; but they often appear of a greyish cast, from the thin skin with which they are invested, and which is of this latter colour.

The tongue of these animals is most remarkable for its size, being comparatively large in all the species, but particularly so in the *balænæ*. In substance it varies in the different tribes, being of a firm texture in the porpesse, grampus, and other dolphins, but soft and spongy in the proper whales. In these latter the tongue, both in size and substance, has been compared to a feather bed. It is composed partly of muscle, and partly of fat, with which it so abounds in the *balænæ*, as often to produce several tons of oil. In some species it is covered with a fine smooth skin, while in others it is rendered rough on the surface by numerous papillary protuberances. It is usually pointed at the anterior, or *antinial* extremity, and serrated on the edges. It projects most in those species that are furnished with teeth.

The *æsophagus*, or gullet of cetaceous animals, has, with respect to its general structure, been sufficiently described under *Comparative* ANATOMY. Its diameter differs considerably in different species. In the Greenland whale, the largest of the class, it is so small, as with difficulty to admit the passage of a hen's egg, while in the piked whale it has been observed 3½ inches wide, and in some other species it is probably much wider. It is proportionally widest in the dolphin tribe, especially in the dolphin and the porpesse.

The cetacea resemble the ruminating quadrupeds in the complicated structure of their stomach. This organ consists of four, and sometimes five distinct cavities, connected with each other in a manner somewhat different from those of the ruminating quadrupeds. In the *dolphin* and *porpesse*, (which we may quote as among the most familiar and procurable examples,) the first stomach is the most extensive, and of an oval form, having on its central surface thick circumvolutions, and elevated ridges round the orifice, by which it communicates with the second stomach ; thus preventing the return of the food from the latter into the former. The second stomach is also oval, and rather less than the first ; marked internally with longitudinal rounded channels, united by others that cross them transversely, like the fingers of the two hands when joined together. Between the second and the first stomach, and between the former and the third, there is a short canal, which forms a narrow passage from the one to the other. The third stomach is lengthened out like an intestine, and curved in the form of an *S* ; its sides are much finer than those of the two preceding, and its central or internal surface is smooth, soft, and without wrinkles. Its outlet into the fourth stomach is contracted by a sort of *pad*, formed by the three membranes. The fourth stomach is the least of all in capacity ; it is short and small externally, and its structure appears the same with that of the third. Its outlet is marked by a simple structure, without any elevation or valvular fold.

The rest of the intestinal canal is usually very long, and the folds of its central membrane remarkably distinct and protuberant, so as to render the whole cavity of a cellular structure, the folds acting as so many valves that impel the contents forward, but prevent their return. The distinction into small and great intestines is also very evident. The most sacral part of the intestines, or *rectum*, appears contracted, is glandular, and covered by a soft cuticle, and its termination in the *anus* is very small.

The food of cetaceous animals is different, according as they are furnished with teeth, or destitute of these organs. The *dolphin* tribe live on various species of fish, especially cod-fish, *flat fish*, and *dog fish*. Some of the more ravenous of this tribe, as the *grampus*, will prey on others of their own tribe, and will even attack the larger whales, and suck their blood. Those of the *physeter* tribe, or the *spermaceti whales*, are said to feed on the smaller of the dolphin tribe, and on *seals ;* and the *large spermaceti whale* is said to pursue with avidity the *shark*, which is supposed to constitute a great part of his natural food. The *balænæ* and the *narwhals* live chiefly on various species of *mollusca*, such as *actiniæ* and *medusæ*, though some of them certainly devour large quantities of *herrings*, and other smaller fishes. These they swallow whole.

SECT. IV. *Circulation.*

There is little remarkable in the conformation of the circulating system of the cetacea, which differs from that of MAMMALIA in few particulars. Their heart is proportionally larger and flatter ; their *vena cava* larger ; and the arteries in many parts more tortuous, and more divided.

The quantity of blood that circulates within the vessels of some of these animals is prodigious. It is calculated, that in some of the larger balænæ, the diameter of the *aorta* often exceeds 13 inches, and that the heart in these species is capable of projecting from its ventricles ten or fifteen gallons of blood during one pulsation. The blood of cetacea scarcely differs in its nature and appearance from that of quadrupeds.—Hunter, in *Phil. Trans.* vol. lxxvii. p. 416.

It has been supposed by some naturalists, that the passage which is usually found in the *fœtus* of man and MAMMALIA, immediately connecting the ventricles of the heart, and which has been called by anatomists *foramen ovale*, (see ANATOMY, vol. i.) continues open after birth in the cetacea, and other animals that pass much of their lives under water ; but this opinion, at least with respect to the cetacea, is erroneous. Indeed, if we consider the short time during which these animals can keep entirely below the surface of the water, (which seldom exceeds twenty minutes,) it must be evident, that their necessity for frequent respiration is nearly equal to that of quadrupeds ; and that they therefore possess a similar system of circulating and respiratory organs.

SECT. V. *Respiration.*

The structure and physiology of the respiratory organs in cetaceous animals, deserve particular attention, as they exhibit peculiarities not to be found in any other class of animals, and are in themselves sufficient to distinguish the cetacea from the mammalia. Many of the amphibious quadrupeds, especially the *manati*, have fins resembling those of the cetacea, but none of them possess the peculiar *larynx* and spout holes of the latter.

The *larynx* consists of the same number of cartilages with that of quadrupeds, but their appearance and articulation are somewhat different. In some species, as the porpesse and piked-whale, the *os hyoides* consists but of one piece, while in the dolphin, or bottle-nosed whale, it is composed of three pieces, besides two additional cartilages attached to it from above. This bone has no attachment to the head by means of other bones, as is the case in many quadrupeds. The thyroid cartilage differs in figure in the several species, but in general it is broader laterally, than from the atlantal to the sacral edge (from above downward.) The cricoid cartilage is broad and flat, and deeper laterally and on its dorsal part, than on its sternal side. It is extremely thick and strong. The two arytenoid cartilages project considerably, and are united to each other almost to their extremities. The epiglottis is sometimes not attached to the arytenoids, while in others it is so united to them, as to form with them a complete canal, terminating in the glottis. In this latter case, the passage through the glottis is very much contracted, but below this contraction the *trachea* swells out into a tube of considerable size. From this peculiar structure, Mr Hunter was of opinion that these animals possess no voice; though we are assured by many observers, that they emit sounds resembling a sort of dull bellowing or lowing.

The lungs have little peculiar, except that they are long and thin, and closely attached both to the pleura and the diaphragm. They are also not divided into lobes, as in man and quadrupeds, and are of a firmer texture.

The diaphragm is attached at its sternal edge to the abdominal muscles, whence it passess obliquely backwards, and is inserted into the spine much more sacrad or lower than in quadrupeds. This muscle, and all those parts concerned in inspiration, are, in the cetacea, exceedingly strong.

There is something peculiar in the structure of the thorax, which is not entirely surrounded by the ribs; hence its cavity is less easily enlarged. This defect is supplied chiefly by the greater proportional strength in the diaphragm, which is hence supposed to be the principal organ of inspiration.

What are called the *spout holes*, or *blow holes*, are two canals situated near the middle of the arch formed by the bones of the cranium, a little behind that part where rises the protuberance in which they terminate by the external orifices. They proceed from the back of the mouth, and after traversing in a curved direction the interior of the skull, open externally in some part of its upper surface. In most species the bony canal is double, and in some the two parts continue distinct as far as the external opening; this is the case in the balænæ. In most, however, the two canals unite near the top of the head, and terminate by a single external orifice. This orifice differs both in form and situation in the several tribes. In the porpesse, grampus, spermaceti whale, and some others, the orifice is transverse; in the balænæ it is longitudinal. It is always situated on that part of the head which is most protuberant. In some tribes this part is near the forehead, in others near the middle of the head. In some, as the balænæ and physeter tribes, its course through the cranium is straight; in others, as the narwhals and dolphins, it is curvilineal.

The most curious part of the mechanism of the blow holes remains to be described, viz. the connection between the bony parts of these passages, and the contiguous membranes and muscles. We have already seen, that the eustachian tube ascends towards the top of the nostrils, and have noticed the cavity or empty space on its internal surface. With this hole are connected several membranous cavities or sinuses, and this compound cavity communicates with the frontal sinuses, by a canal which ascends forwards towards the orbit; but the sinuses have no immediate communication with the nostrils, properly so called.

On examining the gullet in these animals, we find that when it reaches the top of the larynx, it seems to divide into two tubes, one of which is continued into the mouth, while the other ascends towards the nose. This latter is surrounded with glands and fleshy fibres, that form several muscles. Some of these fibres are longitudinal, and are attached round the posterior orifice of the bony part of the nostrils or blow holes, and descend along the tube as far as the pharynx, and down the sides of this cavity; the other fibres are annular, and appear to be a continuation of the proper muscle of the pharynx. Now, as the larynx rises into this canal like a pyramid, these annular fibres are able to compress it by their contractions. The two bony canals near their upper or external orifice are closed by a fleshy valve, in the form of two semicircles, attached to the anterior border of the orifice, which the valve closes by means of a very strong muscle, inserted into the upper surface of the intermaxillary bones. To open the orifice, requires a strong effort from below upwards. When this valve is closed, it intercepts all communication between the blow holes and certain cavities placed above the valve.

These cavities are two large membranous bags, formed of a blackish mucous skin, which are much wrinkled when empty, but when inflated assume an oval form, and are of considerable capacity. These two bags are concealed below the skin, in the fore part of the blow holes. They both open into an intermediate cavity, placed immediately in the blow holes, and communicating with the external air by a narrow circular chink. There is an expansion of very strong fleshy fibres, which covers the whole of this apparatus, proceeding in a radiating form by the neighbouring parts of the cranium, and uniting over the two bags, so as to be capable of compressing these with great force.

Such is the mechanism of the blow holes as described by Cuvier. (*Anat. Compar.* tom. ii. p. 673, &c.) The manner in which the animal employs this structure, will appear from the following considerations.

The cetaceous animals, in their usual attitude, being incapable of breathing through the mouth, have been provided with nostrils, whose external opening is so situated as to project above the surface of the water, while all the rest of their head and body are below it; either for the purpose of concealment from their enemies, or for the pursuit of their prey. In the latter case, as they swim with great velocity with their jaws distended, they receive into the mouth a great quantity of water, which they would be obliged to swallow were it not for that peculiar organization, which enables them to free themselves of this incumbrance during expiration. Now, the blow holes serve both for nostrils, by which to receive the external air into the lungs, when their head is nearly covered with water, and as spouts for ejecting the water received into the mouth with their food. To effect this latter purpose, the animal first moves its tongue and jaws, as in the act of swallowing, and closing its pharynx, it forces the water to ascend into the membranous tube, which we described as proceeding from the gullet, and thence into the blow holes, where its motion is accelerated by the muscular fibres, so as to enable it to raise the valve, and push its way into the membranous bags above. Once arrived here, the water may remain till the animal chooses to eject it. When about to do this, he closes the valve, in order to prevent the water in the bags from regurgitating into the nostrils, and then forcibly compresses the bags by means of the muscular expansions with which they are surrounded. The water thus compelled to issue out by a very narrow opening, is impelled into the air, where it sometimes rises to a very considerable height. The larger whales are said to be capable of forming a jet at least 40 feet high. The noise of these spouts is often heard at a considerable distance, and affords one of the methods by which the fishermen discover that a whale is near.

SECT. VI. *Absorption.*

It does not appear, that the absorbent system of cetaceous animals differs in any remarkable circumstances from that of quadrupeds.

SECT. VII. *Secretion and Excretion.*

Few of the secreting organs in the cetacea require particular notice.

The salivary glands are entirely wanting in those species that are destitute of teeth, and in the toothed species these glands are extremely small. Most of them, however, have a *pancreas*, which is a long flat body, having its left end attached to the right side of the first stomach, and passing across the spine at the root of the mesentery to the hollow curve of the duodenum, to which it adheres. Its duct enters that of the liver, near the termination of this latter in the duodenum.

The liver differs little from that of mammalia. It is divided into two principal lobes, and is closely attached to the stomach on the left side. There is no gall bladder.

In most of the cetacea the spleen is single, as in man and mammalia; but in a few, as the porpesse, it is complex, consisting of several small connected bodies, that are supplied with blood from the arteries of the first stomach.

The most remarkable secretion in these animals, is that peculiar fatty substance commonly called spermaceti. This substance is found in all the species of *physeter*, which are thence called spermaceti whales, though it is most abundant in the large spermaceti whale, (*physeter macrocephalus*). It is found in almost every part of the body mixed with the common fat, but is in greatest quantity and most distinct within the upper part of the head. Hence, the older naturalists have mistaken this fat for the brain of the animal, to which it bears no analogy, and is evidently only a firmer kind of fat.

There are two principal parts of the head in which the spermaceti is contained, some of it being found in the lower part of the cranium, though by far the greater portion lies along the upper part, above the cavity of the brain. Here it is lodged within large cells, divided from each other by ligamentous bands, and cellular membrane. These cells are smallest about the nose, and the fat found in these small cells is considered as the purest.

In its natural state, spermaceti is not nearly so solid as that which we meet with in commerce; a circumstance which arises from its being more or less mixed with the ordinary fat, or blubber. There are, however, often found lumps of a more solid texture, and these are generally preferred by the fishers, and sent home as the best spermaceti.

The urinary organs of cetacea have few peculiarities. The kidneys consist of several small glands, connected together by cellular membrane, blood vessels, and urinary tubes, and not by continuity of substance. The whole together form an oblong flat body, broader and thicker at its atlantal than at its sacral extremity. From this latter proceeds the ureter to the bladder.

The bladder is of an oblong form, and comparatively small, and is perforated by the ureters very near the origin of the urethra.

The renal capsules are also small, of a flattened oval figure, and composed of two substances, of which the more central or internal has most of a fibrous appearance.

Of that peculiar excretion (as it is generally esteemed) called AMBERGRIS, we have already sufficiently treated under that article.

SECT. VIII. *Integumation.*

The integuments of cetaceous animals, like those of quadrupeds, consist of a cuticle, *rete mucosum*, true skin, and cellular membrane, containing a prodigious quantity of fat.

The cuticle resembles that on the sole of the human foot, consisting of several layers, forming altogether a dense, tough, inelastic substance. Its outer surface is smooth, and often bright and resplendent, owing to the quantity of oil with which the membrane is imbued. It is perfectly free from hairs or scales, but is pierced with a multitude of large holes or pores. Its inner surface is rough, and in some of the larger species resembles the pile of coarse velvet. The cuticle is of various colours in the different species, but in general that on the upper or dorsal part of the body, is of a dark colour. Sometimes it is spotted, as in the narwhal, or piebald, as in some balænæ. Several species are half brown and half white, and some are striped with black or yellow. Often the upper part of the body is brown or black, whilst the belly is of a dazzling whiteness. Almost all the whales about Spitzbergen are entirely white. These differences are not always specific, but often depend on the age or sex of the animal, or the climate in which he resides.

The *rete mucosum*, which separates the cuticle from the skin, is much thicker than in quadrupeds, and it is this membrane which gives to the animal the colour that shines through the cuticle. It is probable that what we have, after Mr Hunter, described as the inner or central surface of the cuticle, is really a layer of *rete mucosum*.

The peripheral, or outer surface of the outer skin, is extremely villous, and in some parts formed into small ridges, like those on the tips of the human fingers; the *villi* are soft, elastic, and vascular, and are often of great length. Thus, in some of the *spermacceti whales*, they are at least ¼th of an inch long. The skin of cetaceous animals possesses but little elasticity, and is in most species stretched to its utmost extent above the fat. The piked-whale, however, affords an exception to this remark, as the skin of the forepart of the neck and breast, as far back as the middle of the belly, is, in that species, very elastic, and formed into longitudinal ridges, like a ribbed stocking. The whole skin, including *rete mucosum* and cuticle, is of considerable thickness.

Between the skin and the muscles lies the adipose or cellular membrane, which is loaded with a prodigious quantity of fat. This, with its contained oil, is what the Greenland fishermen call blubber, or *spick*. It is composed of numerous membranous cells, connected with each other, and intermixed with a denser ligamentous substance. Its thickness varies considerably. In some of the larger balænæ it is from ten to twenty inches thick, while in the smaller cachalots and dolphins, it does not exceed three or four.

The oil contained within the cells of the blubber appears to be the most fluid of all animal fat. It is naturally of a softer consistence than hog's lard, and is sometimes so fluid as to drop out from the cut surface of the blubber, without either expression or boiling. This fluid oil is not, however, confined to the blubber, but is yielded in considerable quantity by the bones of the head, especially the lower jaw-bones and the tongue. Its nature and properties are well known.

SECT. IX. *Reproduction.*

In the organs and function of reproduction or generation, these animals very nearly resemble quadrupeds, especially those of the ruminating order. The male has a penis, testicles, and *vasa deferentia;* the female a *vagina*, a *clitoris*, and a *uterus*, with its ovaries and Fallopian tubes; but from the different form of these animals, the situation of those parts, especially in the female, is different from that of the same organs in quadrupeds.

The milk of the female cetacea resembles that of the cow, but is said to have a richer taste, like cow's milk with the addition of cream.

The function of generation in these animals is involved in much obscurity, and various conjectures have been advanced respecting their mode of copulation, their period of gestation, and the posture in which they suckle their young.

By some it has been affirmed, that they copulate in an erect posture, with their heads far out of the water; and there seems no doubt that they have been observed in this strange posture, embracing each other with their swimming paws. Others, with much less probability, have pretended that, during copulation, the female is extended on her back, a position which cannot be long preserved, from the necessity of frequent respiration.

Their period of gestation is not known, but it is conjectured that they carry their young ten months, and admit the male only once in two years, being thus supposed to give suck above a year. They generally bring forth only one at a birth, though they have sometimes been seen with two under their protection.

Some authors pretend to describe the method in which the female suckles her young. We are told by Gerardin, that when she wishes to give suck, she approaches the surface of the water, and turns herself upon one side; she then swims sidewise, and by frequent and gentle oscillations, she places herself, sometimes above and sometimes below her young one, according as she or it can spout out through their blow-holes the water which rushes into their mouths, and thus alternately respire.

Nothing can be more uncertain than the age which these animals are capable of attaining. They have been considered as the very emblems of longevity, and the larger species are described as passing above 1000 winters among their native ice. All this, however, must be purely conjectural; and it is only from the analogy supposed to subsist between them and the larger quadrupeds, that we can at all guess at the duration of their lives. In this way we may suppose, that if the elephant lives above 100 years, the Greenland whale, which is nearly ten times the size of that vast quadruped, should live about ten centuries.

EXPLANATION OF PLATE CXXXIII.

The figures of this Plate are intended to illustrate the structure of cetaceous animals, described in the preceding pages.

Fig. 1. A view of the bones of the atlantal extremity, or *swimming paw*, of the dolphin. *a*, the humerus; *b*, the radius; *c*, the ulna; *d*, *e*, *f*, *g*, *h*, the metacarpus; *i*, *k*, *l*, *m*, *n*, the phalanges of the fingers.

Fig. 2. A horizontal view of the tail of the piked-whale, figured in Plate CXXXIV. Fig. 2.

Fig. 3. The skull, jaws, and teeth of the dolphin.

Fig. 4. The usual position and form of the teeth in the physeter tribe.

Fig. 5. The tusk or horn of the narwhal.

Fig. 6. The general appearance of the horny plates of whalebone in the balænæ, shewing their relative situation, and the hairy edges in which they terminate.

Fig. 7. A view of the general form and proportions of the complicated stomach of cetacea, as seen in the porpesse; *a*, the gullet, where it joins *b*, the first stomach; *cc*, the second stomach; *ddd*, the third stomach; *e*, the fourth stomach; *f*, the pylorus.

Fig. 8. A side view of the muscular and bony parts connected with the blow-holes in the dolphin; *a*, the tongue, seen from above; *bb*, the nostrils; *c*, the pharynx; *d*, the larynx; *e*, the left horn of the *os hyoides; f*, the stylo-glossus muscle.

Fig. 9. A horizontal view of the same parts dissected, so as to shew, *a*, the common opening of the blow-holes; *b*, the right membranous bag; *c*, the left bag inflated; *dd*, the second layer of muscular fibres attached to the membranous bags.

Fig. 10. A view of the organs of reproduction in the male porpesse; *a*, the urinary bladder, seen from above; *bb*, the ureters; *cc*, the *vasa deferentia; dd*, the commencement of the two branches of the *corpus cavernosum penis; ee*, the muscle which envelopes the prostate gland, and the beginning of the urethra; *ff*, the two bones that answer to the pelvis of quadrupeds; *g* the *rectum; h*, the anus; *ii*, the two retractor muscles or ligaments; *kk*, the glans; *l*, the external orifice of the urethra.

PART II. NATURAL HISTORY OF THE SPECIES.

The number of tribes and species into which cetaceous animals have been divided, varies in different authors. In the last edition of Linné's *Systema Naturæ*, edited by Gmelin, the *Genera* are still only four in number, viz. Balæna, Physeter, Delphinus, and Monodon; but the whole number of species is fifteen. In the *Cetologie* of Bonnaterre, forming the description of the plates of *cetacea* in the *Encyclopédie Méthodique*, the species of Linné's four *genera* described amount to twenty-five. La Cépède, in his *Histoire Naturelle des Cetacés*, has augmented the *genera* to ten; dividing Linné's genus Balæna into two, Balæna and Balænoptera; forming the *Monodon spurius* of Bonnaterre into a new genus Anarnacus; dividing the Physeter of former naturalists into three tribes, Catodon, Physalus, and Physeter; and their Delphinus into two, Delphinapterus and Delphinus; and constituting a new *genus*, Hyperoodon, for the sake of an anomalous species, which some have ranked as a Delphinus, while others have considered it as a Balæna. This distinguished naturalist has swelled the list of species to thirty-four; but he has done this by introducing as *species*, what the best writers before him have, we think very justly, regarded as varieties. Though La Cépède's *Genera* have been adopted by the author of the article Classification in Rees's Cyclopædia, we have not ventured to follow him implicitly, as we are not satisfied with this minute frittering down of the established divisions. We have, however, adopted three of his new genera, thus forming seven tribes.

Order I. EDENTATÆ, or Toothless Cetacea.

Genus I. Balænæ, *Common Whales*.

In this tribe there is no appearance of a fin on the back, though two of the species have there one or two protuberances. There are always two distinct blow-holes, situated on the most prominent part of the head. Their head is very long and large in proportion to the size of their body, occupying a third or fourth part of their whole length; exceedingly deep from the crown to the base, but compressed upon the sides; broadest near the middle, and diminishing a little towards the snout. The jaws are nearly equal in length; but the lower jaw is broader than the upper, and has a furrow for receiving the lower edge of the horny plates or whalebone, that are suspended from the palate. The eyes are small, and placed a little above the angles of the mouth, and there are two small external orifices behind the eyes, that form the external auditory passages.

There are four species, all confined chiefly to the northern ocean, off the coasts of Greenland, Iceland, and North America.

The following are the most deserving of notice.

Species 1. *Balæna Mysticetus*; Black, or Greenland Whale.

Baleine Franche. Bonnaterre. Encyclo. Method. *Des Cetacés*. La Cépède, Hist. Nat. des Cetaces. *Balæna Major Bipinnis*, Sibbald, Phalainolog. Nov. *Common Whale*, Pennant, Brit. Zool. vol. iii. *Great Mysticete*, Shaw, Gen. Zool. vol. ii. part 2.

This is supposed to be the largest animal which has yet attracted the observation of naturalists; and unless we can attach more credit than they seem to deserve to the wonderful accounts given by Pontoppidan and some other northern writers of the *kraken*, whose immense body lies stretched like a moderate sized island, and the *sea-snake*, that rears its head above the topmast of a man of war, there appears little reason to doubt the supposition. Individuals of this species are often caught, that measure about 60 feet in length, and nearly 40 in circumference; and we are informed, on very credible authority, that whales of at least twice these dimensions have formerly been taken. To this latter size we must at present limit our belief, though ancient naturalists have given accounts of whales above 900 feet long. We are, however, disposed to think, that those writers who discredit the accounts of voyagers and historians of the whale fishery respecting the great size of whales formerly taken, are not warranted in their disbelief, because they themselves have not seen any of those large dimensions. There can be little doubt, that one natural effect of the long war which man has carried on against these animals, must be to diminish their number, and more especially that of the larger individuals, which, from being more profitable, would be more coveted. Hence it may readily be conceived, that the whales now taken are very inferior in size to those killed at or near the commencement of the whale-fishery.

When this species is seen from a distance out at sea, it appears like a dark unformed mass, floating a little above the surface of the water; but when viewed under favourable circumstances, he is seen to have a cylindrical body, the diameter of which is greatest a little behind the swimming paws, whence it tapers considerably towards the tail, and slightly towards the insertion of the head. Near the junction of the tail and body, the skin has a ridged appearance.

The head is of a triangular shape, with the vertical angle at the snout considerably rounded. It is convex above, where, near the neck, there is a considerable protuberance, in the fore part of which are seen the blow-holes. The under part of the head, or lower jaw, is flattish, and the two bones by which it is formed are curved, and pointed at the anterior or antinial ends. The lips are of enormous size; are fixed at right angles to the base of the head; are firm and hard, and overlap each other in such a manner, that when their opening is viewed sidewise, it has nearly the shape of an ∽ placed horizontally. This opening extends towards the base of the swimming paws, till it reaches beyond the protuberance at the top of the head. The eyes are covered with large thick eye-lids, though, from the quantity of fat below the skin, these lids are scarcely moveable.

The tail resembles a cone, with its base arising from what may properly be called the body; and the two fins in which it terminates behind are broad, and curved at the farthest edge, so as to resemble an Italic *S*. The whole tail is extremely moveable, and has very powerful muscles attached to it.

The prevailing colour of this species is a shining black on its upper or back parts, while the fore-part of the under jaw and a little of the belly are white; and the under part of the body, towards the origin of the tail, is generally grey. The blubber of a healthy whale is generally of a yellow colour.

The female whale is said to be usually larger than the male, and is generally known at a distance by having a young one under her protection. These young whales are of a lighter colour than their dams. They have received from the fishermen various names, according to their age. For the first year after birth, while they remain with the mother, they are called *short-heads*, and are so fat, that one of an ordinary size will yield 50 barrels of blubber. When two years old, they are denominated *stunts*; as they thrive so little for some time after quitting the dam, that they will not yield more than twenty barrels of blubber. After this, till nearly full grown, they are called *skull fish*.

At present, the large whale seems to be confined to the regions about the north and south poles, especially off the coast of Greenland, Iceland, Spitzbergen, and Davis's Straits, in the neighbourhood of the former. There is no doubt, however, that this enormous animal has been occasionally seen in almost all the watery regions of the globe; especially at the mouth of the river St Lawrence, off Newfoundland, on the western coast of Mexico, off Ceylon, and the island of Socotra, in the neighbourhood of the Persian Gulf, on the eastern coast of Africa, and near Madagascar, in the Bay of St Helena, and even off the coast of Guinea. Individuals have now and then appeared in the Baltic, and in the Mediterranean sea; and more than one instance has occurred of the whale appearing off the British coast. Indeed, if we are to credit the relations of the ancients, the largest whales were formerly seen near the coast of Britain. Thus Juvenal, comparing great things with small, uses the following illustration:

> Quanto Delphinis Balæna Britannica major.—Sat. x.

Various accounts have been given of the food of the whale; but it is generally believed, that it subsists almost entirely on various species of *mollusca*, especially *medusæ*, the *clio-limacina*, shrimps, and crabs. When it feeds, it swims with considerable velocity, with its head below the water, and its mouth wide open. Thus, the animals that enter its mouth are entangled by the hairy parts of the whale-bone, as in a net, while the water that enters with them either runs out again at the corners of the mouth, or, when the animal attempts to swallow, is ejected with great force through the blow-holes.

The whale is said to be capable of swimming at the rate of eight or nine miles an hour. It seldom remains long at the surface, nor can it stay below water above twenty minutes. It is, however, said to sleep at the surface, with its back and the summit of its head just out of the water.

When the female whale has a young one under her protection, she is extremely tender of it, carrying it with her wherever she goes, protecting it from injury, and even when pursued supporting it with her swimming paws. When wounded, she still continues to clasp it; and when she plunges below the surface, and in vain endeavours to escape her pursuers, she carries her young one with her to the bottom, though, more mindful of its necessities than her own safety, she emerges sooner than usual, to allow it to respire. It is considered very dangerous to attack a mother whale, as she is extremely ferocious in defence of her young one, lashes with her tail in the most furious manner, and, in rising from the bottom, not unfrequently endeavours to overset the boats with her enormous back.

One might imagine, that an animal of such vast bulk and prodigious strength, might roam through the ocean without the dread of any other created being; and yet, besides his most formidable enemy, *man*, he is exposed to the attacks of a great variety of foes. The sword fish (*Xiphias Platypterus*, Lin.), the saw-fish (*Squalus pristis*, Lin.), and the gladiator dolphin, or sea sword, attack him with the formidable weapons with which nature has provided them, and cut and tear his flesh, till, overcome with pain, fatigue, and loss of blood, he yields to an enemy as insignificant in bulk, when compared to himself, as a pigmy when set beside a giant, and whom a single blow with his tail, were he allowed to strike it fairly, would almost instantly destroy. The gladiators beset him in numerous packs; and, when overcome with fatigue in resisting these assailants, he lolls out his tongue, the ravenous animals seize on it, and tear it piecemeal from his mouth. Another species of shark, commonly called the sea-bear, attacks the whale in its belly, where it fastens itself by its five-fold range of pointed teeth, and either gnaws off pieces of flesh and blubber, or sucks the blood of its helpless prey.

There are two other animals, much less formidable, indeed, than those which we have mentioned, that feed on the whale; a species of lepas, which adheres to his body, especially below the swimming paws, and a crustaceous animal, called the whale-louse, which attaches itself so firmly to the skin, that it is almost impossible to tear it away. It is probable that these parasites occasion an intolerable itching, as the whale is said to strike himself against rocks and ice-hills, with the view of freeing himself from such troublesome companions, and often receives considerable injury in these fruitless endeavours.

In speaking of man as the great enemy of the whale, we shall not at present enter on any account of the Whale-Fishery, which we shall reserve for a future article; but it may be proper here to notice, as an interesting part of his manners, the way in which he conducts himself when attacked by the fishing-boats. As soon as he perceives himself wounded, he flies off with extreme rapidity, swimming to a distance, and at the same time diving towards the bottom. His flight is so rapid, that were the coil of rope to which the harpoon is fastened to be in the least entangled, the boat and her crew would be instantly overset, or hurried to the bottom; and, were it not for the precaution of continually wetting the rope, its friction against the gunwale would set the boat on fire. When fatigue and want of breath compel him to reascend to the surface, he is immediately, on coming into sight, attacked by another harpoon from the same, or another boat, and flies off with the same rapidity as at first; but from his second flight he is soon obliged to return: thus, by successive wounds, and the consequent fatigue and loss of blood, he is rendered incapable of farther resistance. He is then secured by a hawser, or small cable, and towed by several boats towards the ship. Even then, however, it is dangerous to approach him, as he lashes furiously with his tail, and would soon sink or disable the largest boat. When dead, the carcase floats on the surface of the water, with the belly upwards.

There are few parts of the whale which may not be converted to some use. The consumption of the oil drawn from its blubber, in the burning of lamps and the dressing of leather; and of the horny plates, or *whalebone*, for stays, corsets, umbrellas, handles of whips, and ramrods for fowling-pieces, is well known. The intestines are used in some countries instead of glass for windows; the tendons split into fine fibres, to supply the want of thread; the hairy part of the whalebone in constructing fishing nets and lines; and the ribs and jawbones as beams and rafters for houses. Even the flesh is eaten by the inhabitants of Greenland, and the heart and tongue are esteemed great delicacies.

Species 2. *Balæna Nordcaper*, Iceland Whale.

Balæna Mysticetus, Var. B. Linn. Syst. Nat. a Gmelin. *Baleine Nordcaper*, Bonnat. Descr. D'Island, La Cépède, Hist. Nat. des Cetaces, p. 103. *Balæna Glacialis*, Klein, Miss. Pisc. *Nordcaper*, Anders. Island.

This species differs from the preceding, chiefly in having a more lengthened body, and a proportionally smaller head. It seems to agree with it in the absolute length of the body. Its head has the appearance of an ovoid, truncated behind; and this form is given it more particularly by the under jaw, which is very round and deep, and very broad in proportion to the upper. The point of the snout appears a little hollowed, and the plates of whalebone are much shorter than those of the common whale. The two blow-holes are separated but to a little distance from each other, and have the form of two crescents, with the concavities opposite each other. The inner surface of each plate of whalebone is beset with black hairs, but its external surface is entirely destitute of hair, and is smooth, and even soft to the touch. The eye, which is very small, has its largest diameter placed obliquely.

The swimming paws are situated at about a third part of the whole length of the animal from the snout, and are so long as to equal a fifth part of the whole length.

The tail, which is slender, and very tapered, is terminated by a hollow fin, the lobes of which, measured from tip to tip, extend to about $\frac{3}{7}$ of the whole length of the animal.

The general colour of this whale is a grey, more or less bright, shaded occasionally with irregular and confused spots of grey and black, but the lower part of the head is of a brilliant white colour.

The Nordcaper inhabits the northern ocean, especially about the coasts of Norway and Iceland.

It is said to live chiefly on herrings, medusæ, and some species of helix. When this animal swims at the surface of the water, every part of its body is plunged below the water, except the top of the back and the orifices of the blow-holes. He swims with great agility, and is so ferocious as to render it difficult and dangerous to approach him. Hence his pursuers are obliged to use considerable caution; and when the harpooner has struck the animal, the boat instantly retreats, and a fresh wound is inflicted by the harpooner of another boat, and so on till the animal is dispatched. Each harpoon is distinguished by a particular mark, and that which appears to have inflicted the fatal wound, entitles its owner to a certain reward. Anderson, in his account of Iceland, gives an account of the Icelanders method of taking this animal, which has too much appearance of the marvellous to be easily credited, and is contradicted by Horsebow, who describes the method we have already mentioned from his own observation.

GENUS II. BALÆNOPTERA. *Finned Whales.*

The animals of this tribe agree with the Balænæ, in having the upper jaw furnished with horny laminæ, being entirely destitute of teeth, and having two distinct orifices to the blow-holes, placed towards the middle of the upper part of the head. They are distinguished from the Balænæ, in being provided with a dorsal fin.

La Cépède divides this genus into two sections. The first of these is distinguished by having the throat and belly destitute of folds. The second has longitudinal folds under the throat and belly. There are four species, one belonging to the first subdivision, and three to the second.

Species I. *Balænoptera Gibbar*, Fin-fish.

Balæna Physalus, Linné System. Nat. a Gmelin. *Baleine Gibbar*, Bonnat. Encycl. Method. *Fin-fish*, Marten's Spitzbergen, Penn. Brit. Zool. vol. iii. *Baleinoptera Gibbar*, La Cépède, p. 114.

This species is about 50 feet long, but is not so thick in proportion to its length as the common whale. The whole animal is of a shining brown colour on the upper surface, and a brilliant white below. The head resembles a sort of cone, and is equal to about a third of the whole length of the animal. The eye is situated very near the corners of the mouth, and not far from this point is seen the insertion of the swimming paws, which are of an oval form, and of a length equal to about a ninth part of the whole body. The tongue is not very large. The horny plates are of a blueish colour in the young animal, but of a brown, bordered with yellow, in those more advanced. They are so short as often to be as broad as they are long; but their hairy extremities are long, and appear as if twisted round each other.

This animal is particularly remarkable for its dorsal fin, which is of a triangular form, with the point turned backwards, and is situated at the posterior extremity of the back. It is of considerable length, being, in an individual of the usual size, from three to four feet long. It is from this circumstance that seamen have given to this species the name of *fin-fish*.

It has been found in a great variety of situations, as the Greenland seas, the seas of North America, Indian Ocean, and even in the Mediterranean Sea, one of them having been seen by Marten in the Straits of Gibraltar. Pennant describes it as a British species, and it appears to have been seen off Harwich.

It feeds on herrings, mackerel, a species of salmon, and other small fish.

The fin-fish has very considerable power in the muscles attached to its blow-holes, and is said to eject the water with much more violence, and to a much greater height than the common whale. It also swims with extreme velocity, and easily escapes pursuit.

Whether any particular enmity subsists between the fin-fish and the common whale, is not certain; but it has been remarked, in the seas about Spitzbergen, that when the former makes its appearance, the latter is no longer to be seen.

From the thinness of the body, and of the blubber below the skin in this species, it is not considered as a profitable object of pursuit. An ordinary sized fish is said to yield only 10 tons of oil. The flesh, however, especially that of the swimming paws, is said to be well tasted, resembling that of the sturgeon, and as well as the skin, is eaten by the inhabitants of Greenland.

Species 4. *Balænoptera Acuto-rostrata.* Beaked or Piked-Whale.

Balæna Rostrata, Linn. Syst. Nat. et Fabricii. *Baleine a Bec.* Bonnat. Encyclop. Method. *Balæna ore rostrato*, Klein, Miss. Pisc. *Baleinoptere Museau-pointu*, La Cépède, p. 134.

Of all the whalebone whales, this appears to be the smallest species, seldom exceeding 24 or 27 feet in length. It receives its name from the pointed form of its snout, which is still more acute than that of the second species.

The upper jaw is much narrower and shorter than the lower, though both are lengthened, and terminate in an acute point. The plates of whalebone are very short, of a triangular form, and of a whitish colour, ending below in very long whitish hairs. The number of plates on each side is about 200. The tongue is thick, fleshy, and susceptible of being raised, inflated, and thrust forward to the extremity of the mouth.

The under part of the head, and of the fore part of the body, is covered with a skin that is plaited longitudinally into numerous parallel folds, that extend the whole breadth of the body, from one swimming paw to the other. These folds disappear when the skin is stretched, which, both in this, and the third species, is affected by a particular pouch, placed within the skin of the mouth, between the two branches of the lower jaw, extending below the belly, and which the animal has the power of inflating whenever he finds it convenient to diminish his specific gravity. The whole upper part of the body is of a fine black colour, the lower portion is white, shaded with black, while the furrows between the longitudinal folds, as in the third species, are of a red colour.

The swimming paws appear to be situated higher or lower, according as the animal swims more or less above the surface of the water. The dorsal fin is triangular, a little hollowed in the back part, placed above the anus, and inclined towards the tail. The lobes of the tail are divided from each other by a deep, but narrow cleft.

This is also an inhabitant of the Greenland seas, but has occasionally visited the German ocean. A beautiful individual of this species was caught about 30 years ago on the Dogger Bank, and was brought to London, where it was purchased by Mr John Hunter, and is described and figured by him in the *Philosophical Transactions* for 1787.

The flesh of this species is considered as a great delicacy by the Greenlanders, and they accordingly pursue it with great eagerness. In this pursuit they do not employ the harpoon, but shoot at the animal with arrows.

The piked-whale feeds on most kinds of small fish, which it pursues with such keenness, that its prey is often seen leaping out of the sea, in endeavouring to avoid their merciless pursuer.

ORDER II. PRÆDENTATE CETACEA, *or those with teeth only in the fore part of the upper jaw.*

GENUS III. MONODON, Linn. NARWALUS; La Cépède. NARWHALS.

THE animals of this tribe have a single opening for the blow-holes, situated over the nape of the neck, and instead of teeth have generally a single tusk or horn, (rarely two,) proceeding from one side of the snout, of considerable length, more or less pointed at the end, and spirally twisted. Their head is not so thick or long in proportion to their body, as that of the two preceding tribes, and terminates in an obtuse rounded snout. Their mouth is small, and entirely destitute of teeth, or horny plates. The upper surface and sides of the body are variegated with spots of different forms, and a longitudinal ridge extends from the origin of the tail to a considerable distance along the back. The proper narwhals have no dorsal fin.

These animals live chiefly in the seas about Greenland and Iceland. They feed on the smaller fishes and mollusca. They swim with great velocity, and appear to employ their horns both as weapons, and as instruments for dislodging shell-fish, &c. from the rocks.

There is some ambiguity respecting the species of this genus. Linné described but one species, and naturalists are not yet agreed whether more should be admitted. As, however, there are at least two varieties of these animals, which appear to differ by characters that are sufficiently fixed and permanent, it seems proper that they should be considered as separate species. Accordingly La Cépède has so distinguished them, and Mr Fleming, in an excellent paper on one of these species, in the *Memoirs of the Wernerian Natural History Society*, has followed his example, though his specific characters differ from those of the French naturalist. The names and characters given by Mr Fleming, which we shall here adopt, are as follows.

1. *Monodon Vulgaris*, of a figure approaching to ovoid, with the head equal to $\frac{1}{4}$th of the whole length; the dorsal ridge extending from the tail to the blow-hole, and the lobes of the tail rounded. 2. *Monodon Microcephalus*, with the body of a conical shape, a blunt head equal to $\frac{1}{10}$th of the whole length, the dorsal ridge extending from the tail only to the middle of the back, and the lobes of the tail pointed.

Species 1. *Monodon Vulgaris*, common Narwhal, or Unicorn-fish.

Monodon Monoceros, Lin. Syst. Nat. *Narwal Vulgaire*, La Cépède, Hist. Nat. des Cet. 142. *Narhval, vel unicornu marinum.* Pontop. Nat. Hist. Norw. *Unicorn Narwal*, Shaw, Gen. Zool. vol. ii. part ii.

The common narwhal grows to the length of from 20 to 22 feet, and is about 12 feet in circumference. Individuals of greater dimensions are said to have been seen, but the relations appear not to be authentic. The general figure of the body is oblong and oval, with a broad convex back. The prevailing colour is grey, or light brown, with numerous spots of a darker colour on the back and sides, while the lower part of the head and body is of a uniform shining white.

The head is scarcely to be distinguished from the rest of the body, except by a slight depression, a little behind the opening of the blow-hole. The forehead is low, and not very prominent; the snout is rounded, and obtuse; the mouth so small as, according to some accounts, to be incapable of receiving a body much larger than a man's hand; and the opening of the blow-hole is in the form of a crescent.

The swimming paws are about a foot long, and eight inches broad. The lobes of the tail have a direction away from the body, and are blunt and rounded at the tip. A very conspicuous ridge, several inches high, extends from the blow-hole to the origin of the tail, diminishing gradually in height as it approaches the tail.

The skin is thin, and the blubber in small quantity, though it is said to yield an oil superior to that of any other whale.

The most curious part of this animal's structure is its horn or tooth. This organ is inserted to the depth of a foot or more into the bones of the skull, and from its insertion to near its exit from the head, it is smooth and hollow. From the snout it gradually tapers to its other extremity, and is regularly and gently twisted. It does not stand out from the head in a perpendicular direction, but diverges considerably towards one side, so that in those cases where there are two teeth, their farther extremities are at least eighteen inches asunder, while at the snout their distance is only about two inches. The substance of this horn is exceedingly hard and dense, nearly resembling the tusk of the elephant, but of a finer grain, and less liable to become yellow.

This species has not, we believe, been found beyond the limits of the northern ocean, where it frequents the bays, and those parts that are most free from ice. Here the animals assemble in considerable numbers; and when frightened or pursued, they huddle together, so as often to wound each other with their formidable horns. When this happens, they extricate themselves with difficulty, and become an easy prey to their pursuers. When alone and at liberty, however, they are not easily taken, as they swim with great swiftness, and frequently dive below the surface.

The narwhal is said sometimes to attack the whale. We have some doubts of the accuracy of this assertion, and suspect that the sword-fish, already mentioned as the chief terror of that monster of the deep, has been mistaken for the present species, which seems to be a harmless and inoffensive creature, except when provoked, or rendered desperate by aggression.

The spoils of this animal are of great value. We have already said that its oil is of a very fine quality. Its flesh and intestines are greedily eaten by the Greenlanders, and its horn affords a much finer and better coloured ivory than the tusk of the elephant, and has been employed for making various articles of luxury. Among others, we are told of a magnificent throne entirely composed of narwhals horns, which belongs to the kings of Denmark, and is carefully preserved in the royal castle of Rosenburg at Copenhagen. The Greenlanders employ these horns for more homely purposes, as parts of their buildings.

Species 2. *Monodon Microcephalus*. Small-headed Narwhal.

Narwal Microcephale, La Cépède, Hist. Nat. des Cet. 159. *Small-headed Narwal*, Fleming, Mem. Wern. Nat. Hist. Soc. vol. i. p. 131.

This species is of considerable size, varying from 12 to 26 feet in length, and of proportional circumference. Its body is of a narrower and more conical shape than that of the former species, and its head considerably smaller. Its upper surface is more flat and even. The colour of its upper parts is usually a dusky black, variegated with spots which, from being of a darker hue, are not very apparent. On the sides the spots are more conspicuous, and of an oblong form. The belly is of a white colour. The whole skin is smooth and glossy, very thin, and closely united to the fat. The forehead is high, and rises abruptly from the snout, proceeding afterwards for a few inches in nearly a horizontal direction, till it rises into a slight elevation, in the fore part of which is situated the blow-hole. The mouth is extremely small, and the upper lip extends a little beyond the lower. The eye is situated almost below the opening of the blow-hole, is about an inch in diameter, and has the iris of a chesnut colour.

This species is also a native of the northern ocean, but several specimens of it have occasionally been thrown on the British coast. One of these was cast on shore at Frieston, a village near Boston in Lincolnshire, and an account of it was transmitted by Sir Joseph Banks to M. La Cépède, though this gentleman has, with unaccountable carelessness, described it as having been found in the seas which wash the coast of Boston, in lat. 40°, a description which evidently led to the supposition that the place was Boston in America. Another specimen was cast on shore at the entrance of the sound of Weesdale in Shetland, in the year 1808, and is particularly described by Mr Fleming in the Memoirs already quoted. This individual was only 12 feet long, and apparently had not attained its full size.

The narwhal is mentioned by the late Professor Walker of Edinburgh, (see Walker's *Essays*, p. 227,) as having been frequently seen about the Zetland islands, and he alludes to the common species or *Monodon Monoceros*, Linn. the only species then known.

Genus IV. Anarnacus. *Anarnak*.

Otho Fabricius, in his *Fauna Grœnlandica*, described a species of whale, called by the Greenlanders *Anarnak*, from the purgative quality of its flesh and fat. M. Bonnaterre, in his *Cetologie*, considered it as a species of narwhal, and called it *Monodon Spurius;* but M. La Cépède, with more propriety, has formed of it a new *genus*, with the following character:

One or two small crooked teeth in the upper jaw; no teeth in the lower jaw; a fin on the back. *Hist. Nat. des Cetaces*, p. 164.

Species. *Anarnacus Grœnlandicus*, Greenland Anarnak.

Monodon Spurius, Bonnat. Encyl. Method. Shaw. Gen. Zool. v. ii. part 2. *Anarnak. Grœnlandois*, La Cépède, p. 164.

This is one of the smallest cetaceous animals. It is of an oblong rounded form, and of a black colour. The inside of the mouth is destitute of teeth, the two tusks which characterise the genus being attached to the upper jaw, and each about an inch in length, and covered at the top. It has a single orifice for the blow holes, situated on the top of the head. It inhabits the seas that wash the coasts of Greenland, but seldom approaches the shore.

Order III. SUBDENTATE CETACEA, *or those with teeth only in the lower jaw.*

Genus V. Physeter. *Cachalots*, or *Spermaceti Whales*.

The animals of this tribe are remarkable for the size of their head, which in some species is equal to the half, and in others to the third of the whole animal. The upper jaw is excessively broad and deep, and has usually a few indistinct teeth, almost entirely covered with the gum. The lower jaw is long and narrow, enters into a fissure in the upper jaw, and is furnished on each side with a row of thick conical teeth, more or less obtuse. The blow holes approach each other within the skull towards the fore part of the snout, where they terminate in a common external opening. Below the snout is the principal cavity that contains the substance called *spermaceti;* and it is chiefly from these animals that ambergris is obtained. Some of them have a fin, and others a callous protuberance on the back.

Eight species of this tribe have been distinguished. The following are the most important.

Species 1. *Physeter Macrocephalus*, Great-headed Cachalot, or Great Spermaceti Whale.

Grand Cachalot, Bonnat. Encycl. Method. *Cachalot Macrocephale*, La Cépède, p. 166.

This species grows to the length of nearly 60 feet, and is often 30 in circumference in the largest part of the head. Its head forms by far the most conspicuous part of the animal, and may be said to exceed the rest of the body in magnitude. The back is more or less convex, and near its middle there are the rudiments of a fin, which is short, directed backwards, and appearing as if cut off abruptly at the end. The back of the animal is of a black or slate blue colour, sometimes spotted with white, and the belly is white.

The head has the appearance of an immense box, rounded and obtuse at one end, and rising into a slight convexity at the neck. On each side of the upper jaw is a row of holes for receiving the teeth of the lower jaw, and the intervals between these cavities are filled up with the rudiments of teeth, just appearing a little beyond the gum. The eyes are small, furnished with eye-lids, and situated at a prodigious distance from the snout; the external orifices of the ears are scarcely perceptible; the tongue is of a square form, and of a livid red colour; and the breathing hole is about 6 inches in diameter, and placed just above the end of the snout.

Both the swimming paws and tail are comparatively small, and the lobes of the latter are long and pointed, and have a waving margin. The genital organs resemble those of the other cetacea, and the penis of the male is sometimes eight feet in length.

The great spermaceti whale is found most commonly in the Greenland seas, and about Davis's Straits in North America; but has occasionally been seen in the German ocean, and the British channel. A considerable number of them were cast on shore on the coast of Lower Brittany in France, in the year 1784.

This species feeds on lump fish and dog fish, and is said even to attack and swallow the shark. One of these animals was vomited entire by a spermaceti whale, on being struck by a harpoon in the Greenland seas. The shark was four yards long, and, on opening the stomach of the whale, several fishes bones, nearly a fathom long, were found in it. (Crantz's *Greenland*, vol. i. p. 113.)

It is said to swim with great velocity, and to rise very high above the surface of the water.

This animal yields a considerable quantity of spermaceti, for which chiefly it is taken, though its flesh, skin, tongue, and intestines, are eaten by the Greenlanders. The flesh is of a pale red like that of pork, and the tongue is esteemed a great delicacy when roasted. The blubber is about five or six inches thick on the back, but thinner on the belly. It is not very productive of oil The bones are employed by the Greenlanders to form spears and other warlike weapons, and the teeth resemble ivory.

Species 2. *Physeter Trumpo*, Blunt-headed Cachalot.

Physeter Macrocephalus, Var. Γ Linn. Syst. Nat. *Dudleii Balæna*, Klein, Miss. Pisc. *Blunt-headed Cachalot*, Penn. Brit. Zool. vol. iii. *Cachalot Trumpo*, La Cépède, p. 212.

The length of this species is nearly sixty feet, and its breadth about fifteen. The head is of such an enormous size as to equal the half of the whole animal. The upper jaw is at least five feet longer than the lower, round and obtuse at the snout, and about eight feet deep (from *crown* to *base*). The lower jaw is about ten feet long, very narrow, and having about 18 teeth on each side, all pointing outwards. There is a considerable convexity just above the eye, and a similar prominence below the articulation of the swimming paws. The eye is many feet behind the snout, but nearly in the middle of the breadth of the upper jaw.

The body is irregularly conical, with a prominence on the back, and another on the belly just before the anus. The swimming paws are proportionally larger than in the former species. The penis is eight feet long, and the lobes of the tail measure fifteen feet from tip to tip. The prevailing colour of the animal is a blackish grey.

This species yields a prodigious quantity of very fine *spermaceti*, and its blubber is very productive of oil of a finer quality than that of the Greenland whale.

It is found both in the Greenland seas and in those that wash the shores of New England; and is occasionally seen off the coasts of France and Britain. One was taken near Bayonne in France in 1741, and another was cast ashore on Blyth Sands on the English coast, in 1762.

The blunt-headed cachalot is a bold and daring animal, swims with great swiftness, and, when attacked, turns on its assailants with open mouth.

Species 3. *Physeter Microps*. Small-eyed Cachalot, or Black-headed Spermaceti Whale.

Balæna Major in inferiore maxilla dentata. dentibus arcuatis, falciformibus pinnam sive spinam in dorso habens. Sibbald, Phalain. Raii, Syn. Pisc. *The Parmacetty Whale*, or *Potwal Fish*, Dole Harwich. *Physeter dorso pinna longa, maxilla superiore, longiore.* Artedi Synop. *Cashalot, Catodon, or Potfish*, Crantz's Greenland. *Great-headed Cachalot*, Penn. Brit. Zool. vol. iii. *Cachalot Microps*, Bonnat. Encycl. Method. *Physetere Microps*, La Cépède, p. 227.

There is considerable confusion in the accounts which various writers have given of this species. We have, therefore, given numerous synonimes, and shall take our description of the animal from La Cépède.

" The *Physeter Microps*, (says this author,) is one of the largest, most cruel, and most dangerous inhabitants of the deep. Adding to formidable weapons the two great sources of strength, bulk and velocity, greedy of carnage, a daring enemy and an intrepid fighter; what part of the ocean does he not stain with blood?"

Its head is so enormous, as to equal the whole length of the animal, independent of the tail fin; and it is as large in circumference as any part of the body. The upper jaw, though not extending quite so far as the snout, properly so called, is a little longer than the lower jaw. The teeth which appear in this latter, are conical, curved, hollow towards the roots, and set into the jaw about two-thirds of their length. The part beyond the gum is white like ivory, and its tip acute, and curved first towards the throat, and then a little outwards. According to the most respectable naturalists, the teeth are 42 in number. The upper jaw has cavities for receiving the teeth of the lower; and between them there appear to be short blunt teeth, almost entirely hidden by the gum. The eye is extremely small.

The swimming paws are about four feet long. The dorsal fin is straight, high, and pointed. The whole length of the animal usually exceeds 50 feet, and the skin is of a black colour.

It is found in the Arctic Ocean, and has occasionally appeared in the North Sea. One is described by Sir Robert Sibbald, as having been cast ashore on the coast of Scotland; and so lately as 1769, one of this species was stranded at Cramond, a little above Leith, in the Frith of Forth, and attracted many thousands of spectators from Edinburgh and the surrounding country. La Cèpéde gives an account of 17 that appeared in 1723, in the mouth of the Elbe, and were mistaken by the fishermen of Cuxhaven for so many Dutch fishing-boats.

This animal attacks not only porpesses and other smaller cetacea, but even the largest species of balænopteræ, especially the pike-headed and piked whale, on which it fastens with its crooked teeth, and tears pieces from their bodies. It is said also to pursue the young Greenland whale, which it compels to fly for refuge through the boundless ocean.

Its flesh is esteemed a great delicacy by the Greenlanders, and it yields a great quantity of spermaceti, though but little oil.

La Cépède supposes this animal to have been the sea-monster from which Perseus delivered the fair Andromeda; and he labours to prove, that the *Orca* described by Pliny, as having been attacked in the port of Ostia, by the emperor Claudian at the head of his troops, was not a *Grampus*, but a *Physeter microps*.

ORDER IV. AMBIDENTATE CETACEA, *or those with teeth in both jaws.*

GENUS VI. DELPHINUS. *Dolphins.*

THE animals of this genus are smaller than most of those of the preceding tribes; the largest species scarcely exceeding 25 feet. Their jaws are lengthened considerably, but are of equal length, and are each furnished with a row of conical teeth, more or less numerous in the particular species. The blow-holes, after traversing the upper jaw, unite without in a single orifice, which is in the form of a crescent, and is situated at the top of the head. Their eyes are situated near the angle of the mouth. All the species but one are furnished with a dorsal fin, which is sometimes of enormous length. They are not confined to the northern ocean, but are found in most seas, and in the mouths of large rivers.

The number of species is variously marked by different authors; some, with Linné, reckoning only four, while others extend them to the number of eight or nine. We shall describe but four.

Species 1. *Delphinus Phocæna;* the Porpesse, or Porpoise.

Tursio, Rondelet, Hist. des Poissons. *Le Marsouin.* Belon, Des Poissons. *Delphinus corpore fere coniformi, dorso lato, rostro subacuto.* Artedi Synop. *Porpesse*, Willughby, Ichthyol. Raii, Synop. Pisc. Pennant, Brit. Zool. vol. iii. Shaw, Gen. Zool. vol. ii. part 2. *Dauphin Marsouin*, La Cépède, Hist. Nat. des Cetaces, p. 287.

This is the best known of all the dolphin tribe. It is generally six or seven feet in length; thick in the forepart of the body, and gradually tapering towards the tail. Its colour is a bluish black, or very dark brown on the upper parts, and whitish on the belly. The snout projects a little, but is on the whole short and broad. In each jaw there are about 48 teeth, that are small, sharp-pointed, and a little moveable. The tongue is flat, jagged at the edges, and fastened below. The eyes are small. The tail is semilunar, and the dorsal fin is placed nearer the tail than the head.

This species is well known in all the European seas, and abounds in those of North America. They are seen in greatest numbers about the time when the migratory shoals of fish, as mackerel, herrings, &c. make their appearance, when they are sometimes in such great numbers, as to darken the surface of the water.

They feed on most small fish, especially herrings, whitings, salmon, and sand-eels. They pursue their prey with great eagerness; and in search of those which take refuge in the sand, they burrow with their snouts like a hog. Hence the names of *Marsouin*, *Marswin*, and *Porpesse*, (Sea-swine,) given to them by most of the European nations. They are gregarious, and seem affectionate towards each other. They are often seen to frolic and gambol on the surface of the ocean, a circumstance which is considered by sailors as a sure prognostic of stormy weather.

The blubber of the porpesse is exceedingly thick, and affords a large quantity of excellent oil. The flesh is by no means ill-tasted. It was formerly considered as a sumptuous article of food, and was occasionally introduced at the tables of the English nobility. It was eaten with a sauce composed of crumbs of bread mixed with sugar and vinegar, and called *porpesse sauce.* In America, the skin is used by the poor inhabitants for making waistcoats and breeches, and is said to form an excellent covering for coaches. For these purposes it is pared on the fleshy side till it becomes nearly transparent, and is afterwards tanned and dressed with considerable care.

The inhabitants of Canada, about the river St Lawrence, adopt an amusing method of taking porpesses. They collect together a considerable number of slender branches of sallows, willows, or similar trees, and stick them firmly into the sand-banks across the mouth of the river, which are commonly left dry at low water, so as to form a long line of twigs, having the upper end connected with the shore, and an opening left next the sea, by which the porpesses may enter. As the tide rises, the water covers the twigs, so as to keep them out of sight, and the porpesses entering the river in quest of their prey, get within the line, where they continue the chace till they find, by the ebbing of the tide, that it is time to retreat into deeper water. They now make towards the sea, but the twigs coming then into sight, and being all agitated by the current of the tide, form such an alarming spectacle, that they retire in great fright from this tremendous rampart. The tide continuing to ebb, the porpesses return from time to time, but not being able to conquer their dread of those terrific twigs, they flounder about till they are entirely deserted by the tide, when the inhabitants, watching the favourable opportunity, commence the attack, and soon overpower the defenceless animals. In this manner, more than 100 porpesses, each yielding about a hogshead of oil, are sometimes taken at a single tide. See Bingley's *Animal Biography*, vol. ii. p. 150.

Species 2. *Delphinus Delphis*; the Dolphin.

Le Dauphin ou Oye de Mer, Belon, Hist. Des Poissons. *Delphinus Antiquorum*, Willughby, Ichthyol. Raii. Synop. Pisc. *Delphinus corpore longo subteriti, rostro longo acuto*, Artedi, Syn. *Delphin*, Anderson's Island. *Dolphin*, Borlase's Cornwall. Pennant, Brit. Zool. vol. iii. Shaw, Gen. Zool. vol. ii. part 2. *Dauphin Vulgaire*, La Cépède, Nat. Hist. des Cetaces, p. 250.

The figure of the dolphin has been greatly misrepresented by painters and sculptors. The recurved tail, the monstrous head with pendant lips, and eyes protected by enormous brows, which we see in the usual painted and engraved figures of a dolphin, are mere creatures of imagination.

The length of this species is often nine or ten feet, and its body is about two feet in diameter at the thickest part, thus being very slender in proportion to its length. It is of a black colour above, and white below. The nose is long, narrow, and pointed, something like the beak of a bird, whence Belon's name of *Oye de Mer*, or sea-goose; but there is a transverse fold of the skin across the upper part of the snout. The number of teeth varies; but according to Mr Pennant, there are usually 21 in the upper, and 19 in the lower jaw; we presume he means on each side. The mouth is very wide, reaching almost to the insertion of the head. The dorsal fin is high, and placed rather nearer the tail than the head; the swimming paws are situated low, and the tail is semilunar.

The dolphin inhabits the Atlantic and Pacific Oceans, and is often seen accompanying ships on their passage to the East or West Indies. It occasionally appears in the British seas.

Like most of their congeners, they live on small fish, though they will eat any offal and garbage that is thrown into the sea. They are said to attack whales; though we suspect those who suppose they have seen such a circumstance, have mistaken another species for the dolphin. They are gregarious, and like porpesses often sport about on the surface, and leap out of the water, so as to be entirely visible. In these leaps, their back is a little curved, but not nearly so much arched as is commonly represented. They are said to change their colour before they die, and again after they are dead: but this is probably a mistake, arising from a different reflection of the rays of light, when the body is in motion, or at rest.

At present the dolphin is scarcely sought after as an object of traffic. Some centuries ago, however, its flesh was reckoned a great delicacy; and we are told by Dr Caius, that one taken in his time was deemed worthy of being presented to the Duke of Norfolk who distributed part of it among his particular friends. It was roasted, and served up with porpesse sauce. It is now seldom eaten, except when young and tender. The best parts are next the head, the rest being dry and insipid.

Perhaps no animal has been more celebrated among the ancient poets and naturalists than the dolphin. It has been held forth as the emblem of affection and philanthropy; was honoured with the title of sacred, and consecrated to the gods, on account of its fondness for the human race. Among other instances, the preservation of Arion the musician, so prettily described by Ovid in his *Fasti*; and the story of Hippo, of whom a dolphin was enamoured, so beautifully related by the younger Pliny in his *Epistles*, book ix. epist. 33, may be recalled to the notice of our readers, though our limits do not permit us to dwell on these amusing fables. Those who incline to give them a fuller examination, may be referred to Pliny's Natural History, and the writings of Athenæus and Ælian.

Species 3. *Delphinus Orca*, the Grampus.

L'oudre ou grand marsouin, Belon, Hist. des Poissons. *Balæna minor utraque maxilla dentata*, Sibbald, Phalain. *Delphinus rostro sursum repando, dentibus latis serratis*, Artedi, Syn. *Grampus*, Pennant, Brit. Zool. vol. iii.; Shaw, Gen. Zool. vol. ii. part. 2. *Dauphin Orque*, La Cépède, Hist. Nat. des Cetaces, p. 298.

This is one of the largest species of dolphin, usually measuring from fifteen to twenty-five feet. It is also remarkably thick in proportion to its length, being from ten to twelve feet diameter in the thickest part of the body. From this clumsiness of figure, it has been called by Pliny an immense heap of flesh armed with dreadful teeth: *cujus imago nulla representatione exprimi possit alia, quam carnis immensi dentibus truculentis.*

In this species, the lower jaw is usually broader than the upper; and the snout is described by most writers as having a turn upwards, though this circumstance is not noticed in the description of La Cépède. Each of the jaws has thirty teeth; of which the foremost are blunt, round, and slender; those behind, sharp and thick. The description of the teeth given by Artedi and Linné, viz. that they are broad and jagged, or serrated, seems to be erroneous, and descriptive rather of the shark than the grampus. According to La Cépède, the number of teeth varies according to the age of the animal.

The dorsal fin is of considerable length, often measuring, according to Dr Shaw, six feet, though La Cépède describes it as not so long. The swimming paws are broad, and nearly of an oval form.

The prevailing colour of the grampus, like that of most other dolphins, is black on the back, and of a snowy whiteness on the belly, while the sides are marbled with white and black; and there is usually a large white spot on each shoulder, or a little behind each eye.

This species inhabits both the northern and southern oceans, is not unfrequently seen in the Mediterranean Sea, and has often been observed in the British Channel.

This is the most ferocious of the cetaceous animals. It spares neither friend nor foe, making prey alike of small fish, seals, porpesses, and dolphins. It is said also to attack the Greenland whale, though, according to the latest and best accounts, it is not the grampus, but the next species, which attack that monster of the deep in packs, as bull dogs bait a bull. The grampus is exceedingly active, and scarcely remains a moment above water; but sometimes, in its eager pursuit of prey, it is thrown off its guard, and allured into the shallows. Under these circumstances, the voracious animal frequently continues to flounder about, either till he is knocked on the head by those who have observed him, or is extricated from his perilous situation by the tide's coming to his relief.

Waller, in one of his poems, has recorded a beautiful example of parental affection in the grampus. A female of this species and a cub, having got into an arm of the sea, were deserted by the tide, and being observed in this situation from the shore, a number of men came down to attack them. Both animals were soon wounded in several places, so that the water was dyed with their blood. They made every effort to escape; and the old one, by superior strength, forced herself over the shallow into the deep water, but, instantly recollecting that she had left her young one in the hands of assassins, she rushed back, and seemed resolved, if she could not prevent the murder of her cub, that she would at least share its fate. Happily for the catastrophe of the tale, she succeeded in her endeavours, and the tide flowing in at the moment, carried them both off in triumph.

It does not appear that the grampus is in any request, even for its oil. Like the wolf among quadrupeds, he seems to be the enemy of his own species, and his carcase is of no value after he is dead.

There are several varieties of this species. One of these is described and figured by Mr John Hunter, in the 77th volume of the *Philosophical Transactions*; and another by Mr Patrick Neill, in his *Tour through some of the Islands of Orkney and Shetland*. This latter variety is called among those islanders the *ca'ing whale*, and has several marks that distinguish it from the ordinary grampus. The nose has no spreading or turning upwards; the upper jaw is broader than the lower; it has commonly only twenty-four teeth in each jaw; its swimming paws are long and narrow; the dorsal fin scarcely exceeds two feet in length; there is no white spot behind the shoulder, or near the eye, and it is often entirely black. It is also capable of remaining ten or fifteen minutes at the surface of the water, and is described as being a harmless inoffensive creature. From all these considerations, Mr Neill is disposed to regard it as a distinct species; but as his description is drawn, not from personal observation, but from the accounts of others, it is probable that the ca'ing whale of Orkney and Shetland is only a variety of the grampus.

Species 4. *Delphinus Gladiator*, Gladiator Dolphin, or Sea Sword.

Delphinus Orca, var. B. Lin. Syst. Nat. *Dauphin épée de Mer*, Bonnat. Encycl. Method. *Schwerdtfisch*, Anderson Island, Crantz's Greenland. *Dauphin Gladiateur*, La Cépède, p. 302.

M. La Cépède has been at considerable pains to distinguish this species from the preceding, and has contrasted them in his table of the cetacea by the following characters: In the grampus, the top of the head is but little convex; the snout proportionally less rounded; the upper jaw a little more projecting than the lower, the teeth blunt-pointed; and the dorsal fin placed towards the middle of the body, and reaching in height to about the tenth part of the animal's whole length: while, in the gladiator, the forehead is very convex; the snout is very much rounded; the two jaws equally advanced; the teeth sharp-pointed; and the dorsal fin seated very near the neck, and extending in height more than one-fifth of the whole length of the animal.

The gladiator dolphin measures from 23 to 25 feet, and its dorsal fin from 4 to 5 feet. The latter is about 18 inches broad at the base, and gradually tapers upwards to a point, so as to become a very formidable weapon. The body is of a brown-black colour on the upper part, and a beautiful white on the belly, with a remarkable streak of black, very long, striped, and pointed, extending from each side of the tail to near the articulation of the swimming paws.

This species is found in the American seas, especially in Davis's Straits; as also about Spitzbergen, in the Arctic Ocean. It has occasionally been seen in the North Sea; and not many years ago, several of them came up the Thames. In the year 1793, an individual of this species that appeared in the Thames, was pierced with three harpoons, and yet drew a boat, with four persons in it, twice from Blackwall to Greenwich, and once as far as Deptford, and at last expired at Greenwich.

The gladiator dolphin is possessed of amazing strength and courage. We are told of one that seized on the carcase of a whale, which several boats were towing away, and in spite of the united efforts of the rowers, bore it to the bottom. These animals go together in large troops, and seldom appear in a smaller number than five or six. They usually live on the smaller fishes, but will attack even the largest whales. It is this species, and not the ordinary grampus, between whom and the young Greenland whale such noted combats take place. A number of the gladiators unite in the attack, and, like a pack of hounds, fasten on the whale in every part. One seizes on the tail, in order to prevent its formidable blows to the rest, while others crowd about the head, and watch the moment when the whale lolls out its tongue, on which the gladiators seize as a most delicious morsel.

The blubber of this species is very thick, and yields a considerable quantity of excellent oil.

GENUS VII. HYPERÖODON.

This genus has been formed by La Cépède, for the purpose of separating that singular animal the *Butskopf*, or *Beaked-whale*, concerning which so much confusion has appeared among preceding naturalists. The distinguishing characters of this genus are, numerous small teeth seated on the palate, and a dorsal fin. There is only one known species, viz.

Hyperöodon Butskopf, or Beaked-whale.

Delphinus Orca (Butskopf), Lin. Syst. Nat. *Butskopf*, Marten's Spitzbergen, Anderson Island, Crantz's Greenland. *Bottlehead*, or *Flounder's head*, Dale, Harwich. *Nebbe Hval*, Pontopp. Norw. *Beaked-whale*, Pennant, Brit. Zool. vol. iii. *Dauphin Butskopf*, Bonnat. Encycl. Method. *Hyperöodon Butskopf*, La Cépède, p. 319.

The general form of the body is that of a cone, the base of which is seated near the articulation of the swimming paws. The head is nearly as deep as it is long, the forehead is very convex, and the snout flattened and lengthened out like a beak. In the lower jaw there are only two teeth, at the anterior extremity, of a conical form, and pointed at the tip; but round the margin of the upper jaw, and over the whole surface of the palate are numerous minute, unequal, hard, and sharp teeth. The two jaws are nearly of equal length; the tongue is serrated on the margin, adheres to the lower jaw, and in substance resembles that of a calf. The common orifice of the blow-holes has the form of a crescent, with its horns directed backwards. The eye is seated about the middle of the height of the head, a little above the corner of the mouth. The swimming paws are placed very low, at about the same distance from the eyes as these latter are from the snout. The dorsal fin is nearer to the head than the tail, is curved backwards, and is of considerable height. The two lobes of the tail fin are hollowed at the posterior margin, and extend about one-fourth of the length of the animal, from tip to tip.

The butskopf is generally about 24 feet long, by a circumference of about 15 at its thickest part. The prevailing colour is brown, or blackish, with whitish shades on the belly. The skin is thin; the blubber yellowish; and the flesh of a deep red colour. This animal has been found in most parts of the Northern Atlantic, and the icy sea.

Explanation of Plate CXXXIV.

Fig. 1. The Black or Greenland Whale.
Fig. 2. The Piked Whale.
Fig. 3. The Small-headed Narwhal.
Fig. 4. The Blunt-headed Cachalot, or Spermaceti Whale.
Fig. 5. The Butskopf or Beaked Whale. (*f*)

CETUS, the Whale. See Astronomy, vol. ii. p. 729, and p. 771, for an account of the variable star χ *Ceti.*

CEVENNES. See France.

CEYLON.

Ceylon, an island in the Indian Ocean, at the entrance of the bay of Bengal, situated between 79° 50′, and 82° 10′ East Long. and 5° 50′, and 9° 51′ North Lat. It is separated from the Coromandel coast, by the Gulf of Manaar, a narrow strait, full of shoals, which receives the name of Adam's Bridge, because the natives generally believe that at this place the great ancestor of the human race, after his fall, passed from this island, which they imagine to have been the seat of the terrestrial paradise, to the shores of the continent. Many suppose that Ceylon, at a distant period, formed part of India, and was afterwards separated from it by some great convulsion of nature. This island is computed to be about 900 miles in circumference; its greatest length is 280, and its greatest breadth 150 miles.

Mention is made of this island by some of the writers of antiquity, but the accounts which they give of it are very incorrect and contradictory. In modern times, the Portuguese were the first Europeans who visited Ceylon. It was discovered in 1505 by Almeyda, who was accidentally driven from his cruize off the Maldive islands, by the violence of the currents, into one of the harbours of this country. The situation of the island, and the productions in which it abounded, excited him to cultivate a closer connection with the natives, while the difficulty they found in repelling the attacks of the Arabs, rendered them willing to form an alliance with this powerful and enterprising nation. Accordingly, when Almeyda was introduced to the king, he easily succeeded in persuading him to pay the Portuguese an annual tribute of 250,000 lbs. of cinnamon, on condition that they would protect his coast from every hostile invasion. In order, however, to obtain a monopoly of this valuable article, these ambitious adventurers soon attempted to form a settlement on the island. This naturally excited the jealousy and indignation of the native princes; but, after a long and bloody struggle, the Portuguese succeeded in reducing the whole of the coast under their dominion, and drove the Ceylonese to the mountains in the interior parts of the country. From thence the natives made frequent incursions on the coast, and destroyed the plantations of their invaders, while they, in return, exercised towards the inhabitants every species of oppression and barbarity. This desultory warfare was carried on for upwards of a century, and though productive of little advantage, was attended with much bloodshed to both parties. In this state of distress, the Ceylonese were eager to accept the offer of assistance from the Dutch. In 1632, the States, agreeably to a previous treaty, sent a powerful armament to act in concert with the native princes against their oppressors. The struggle which ensued was violent and bloody; every pass, every fortress, was warmly disputed with them; and after the Portuguese were driven from all their stations, except Columbo, the seat of the government, they seemed determined to perish rather than yield it up. The Dutch invested the town, but the besieged baffled all their attempts, and rejected every proposal of surrender with disdain. At length, however, famine and disease began to subdue those brave spirits who had despised death in every other form. After a siege of seven months, Columbo surrendered to the Dutch in 1656; and, by the fall of this place, a period was put to the dominion of the Portuguese in Ceylon, after it had subsisted for about a century and a half.

The joy of the natives at their deliverance from the yoke of the Portuguese, and the gratitude which they felt to the Dutch, seemed at first to have no bounds. The King of Candy cheerfully paid the expences of their armaments in cinnamon, and even conferred on his new allies the principal possessions, from which, by their assistance, he had lately expelled the Portuguese. On the other hand, they expressed the warmest gratitude to the monarch for these concessions; they began to fortify their new acquisitions under the profession of regard to his security; and so well were the natives convinced of their good intentions, that they afforded them every assistance in their power to complete their operations. The parts of the country assigned them were among the best adapted for cultivation on the island, and they also began to turn these to the best advantage. At the same time, they kept up a most friendly intercourse with the natives, so that the Ceylonese viewed their operations without jealousy, and were eager, by their good offices, to shew the gratitude which they felt to the guardians of their coasts. By means of these prudent measures, the colony was quietly brought into a flourishing state, and was even able to depend on its own internal resources. But, unhappily, the Dutch did not long pursue this wise and moderate system of policy. By degrees, they began to extend their posts into the interior of the country, and to seize on every spot which appeared advantageous for cultivation; they also increased their demands on the king for the protection they afforded him; and he quickly found that all the cinnamon which grew in his dominions would not be sufficient to gratify their insatiable desires. At length, enraged by their accumulated acts of injustice and extortion, he suddenly attacked their settlements, and committed the greatest devastations upon them. This breach between the natives and the Dutch was followed by a long course of hostilities, during which much blood was shed, and no permanent advantage gained by either party. The Dutch, however, were the greatest losers in the contest; for though they frequently routed the natives, overrun their country, and laid waste their villages, yet the hardships which they encountered in forcing their way through a country covered with wood and full of defiles, destroyed so many of their troops, that all their successes were too dearly purchased, and, in the end, they were always obliged to abandon the conquests they had made. On the other hand, the incursions of the natives upon their cultivated grounds, though in general temporary, and easily repulsed, frequently destroyed the labours of many years.

These considerations induced several of the Dutch governors to attempt the restoration of tranquillity, rather by conciliatory measures, than by their ineffectual struggles. For this purpose they sent ambassadors to the court of Candy with a variety of valuable presents, and with instructions to gratify the king by all those tokens of respect which have so powerful an effect on uncultivated minds. The letters to him were wrapped up in silks, embroidered with gold and silver, and the ambassador carried them all the way on his head, the highest token of respect known in that country: in these letters they also dignified the king with many of those high titles, which are usually conferred on eastern monarchs. These conciliatory measures never failed to produce a considerable effect. But few of the Dutch governors were either sufficiently enlightened or disinterested to persevere in them. The renewed oppressions of the Dutch was the constant signal for the renewal of hostilities between them and the natives; and in consequence of a long course of warfare, the Ceylonese became both brave and dexterous. The Dutch were frequently repulsed even in close combat; several of their forts were taken; and whenever they attempted to penetrate into the interior of the country, they commonly lost large parties of their men in attempting to force the woods and defiles, or by the ambushes which their active and vigilant enemy set to surround them. At length, indeed, they triumphed over all these obstacles. The King of Candy saw those woods burst through, which he looked upon as an impenetrable barrier, and he beheld the Dutch soldiers in those vallies which he supposed could never have been approached by a foe. He was twice driven from Candy, the capital of his dominions, and forced to seek for refuge in the mountains of Degleggy, the highest and most inaccessible in the kingdom. Here, however, he found himself secure from the pursuit of his enemies, and contented himself with surprising and cutting off the convoys of provisions and stores sent up from the coast, till they should of their own accord abandon his dominions. This, after all their victories, they were constantly obliged to do. The last great war between them was about the middle of the 18th century, and though the Dutch suffered many disasters during the contest, they at length, by depriving the Candians of salt at pleasure, compelled them to comply with all their demands. In 1766, the king agreed to a treaty, by which, among other articles, all those parts of the coast which had not formerly belonged to the Dutch were to be delivered to them; and they were also to enjoy a monopoly of all the valuable productions of the island, with a great variety of other advantages. On the other hand, the Dutch agreed to supply the Candians, free of expence, with salt sufficient for their consumption. But the articles of this treaty were quickly infringed, and scarcely one of the stipulations was actually fulfilled. Frequent rencounters continued to take place between the Dutch and the natives; but at last both parties became weary of their ineffectual struggles; and hostilities, as well as every kind of intercourse, were broken off as if by mutual consent.

Such was the situation of Ceylon when an attempt was made by the British, in 1782, to obtain possession of the European part of the island. The attack proved unsuccessful at that time, but was again renewed on the junction of the Dutch with the French in the last war. In 1795, a body of English troops landed in Ceylon, and in consequence of the cowardice and want of subordination among the Dutch forces, they found it an easy conquest; indeed, they scarcely met with the semblance of opposition. Since it fell into our possession, we have also been engaged in war with the Candians. In 1798, the king died; and Pelime Talawee, the chief adigar, or prime minister, raised to the throne a young Malabar of inferior extraction, and of no talents, who was only a puppet to dazzle the eyes of the people, while he himself ruled with absolute sway. In 1799, the governor, Mr North, had repeated interviews with the adigar, who, in the last of them, requested our assistance in taking away the life of the king, and placing himself on the throne; and promised, on this condition, to make the British masters of the country. The proposal was rejected with indignation; and, in 1800, the governor sent an embassy to the Court of Candy, with the view of forming a treaty of alliance and commerce between the two nations; but the plan proved abortive, as neither party would accede to the proposals of the other.

After this the Candians appeared to be making preparations for war in all quarters, and as the government, notwithstanding its promises, delayed to make reparation for some small outrages committed on our subjects, the British determined to send troops into their territories, in order to enforce these claims, and to exact security against the repetition of any similar act. Having communicated this intention to the Candian government, and made new proposals of accommodation, without any effect, our forces entered the dominions of the enemy early in 1803, and meeting with little opposition, soon arrived in the capital. This they found had been evacuated on the preceding day by all the inhabitants, and set on fire in several places. Upon their arrival in Candy, the adigar made proposals of peace, and it was agreed that the king should be delivered over to the care of the British government, while Pelime Talawee should be invested with the supreme authority, under the title of Ootoon Komarayen, the Great Prince. In consequence of this agreement, the city of Candy was evacuated by part of the British forces; but, after an unparalleled scene of duplicity and treachery on the part of the adigar, the natives attacked the town; and our troops, under the command of Major Davy, being overpowered by numbers, agreed to capitulate, on condition that they should all be allowed to march with their arms to our settlements on the coast. They were accordingly permitted to take their departure; but they were afterwards forced back to the capital; those of the Malays who refused to enter into the Candian service, were immediately put to death; all the British soldiers were likewise cruelly massacred, excepting three or four, who either made their escape, or were spared by the Candians. The report of these events filled our settlements on the coast with alarm and consternation; and soon after the Candians made various descents on our territories, and even meant to attack the capital, but they were happily driven back by our forces. In 1804, they again made preparations for a general attack on our settlements; but this was prevented by an attack made by us on their own country, which proved on every side successful. In February 1805, they however ventured again to invade our territories, but they were completely routed in every quarter. See Percival's *Account of Ceylon*; Pennant's *View of Hindostan*, vol. i.; Cordiner's *Description of Ceylon*, 2 vols.; and *Asiatic Register*, vol. vi.

From the preceding account, it appears that the island of Ceylon is at present separated into two grand divisions. It originally contained a number of distinct petty kingdoms, but after the arrival of the Portuguese, the whole interior of the country was reduced under the dominion of the king of Candy. The other part of the island, which is now subject to the British, includes the whole of the sea coast, and completely encircles the Candian territories. In some places it extends only about six miles, in others thirty, and on the northern side of the island about sixty miles into the interior.

In approaching this island from the sea, it presents a most delightful prospect to the eye. The level districts on the coast appear bounded by beautiful groves of cocoa nut trees, while the intermediate plains are covered with rich fields of rice, and the prospect usually terminates in woods, which cover the sides of the mountains, and display a verdant foliage during every season of the year. The interior of the island abounds in steep and lofty hills, covered with thick forests, and full of impenetrable jungles. The woods and mountains completely surround the dominions of the king of Candy, and seem destined by nature to defend him against those foreign enemies, whose superior power and skill have deprived him of the coasts.

The highest and rudest tract is the kingdom of Conde Uda; and at the western skirt of the district soars Hamallel, or Adam's Peak, which rises above all the other mountains in the form of a sugar loaf, and is seen even at the distance of the sea. On the summit of this mountain is a flat stone, with an impression resembling a human foot, about twenty-four inches in length, which is said by the Mahometans to be that of our common progenitor; but the Ceylonese consider it as the footstep of Buddhu, their great deity, when he ascended into heaven.

From this mountain and the adjacent hills, the principal rivers in the island take their rise. These are, the Mahavellagauga, the Walluwy, the Cullagauga, and the Moolval. They are, in general, rapid but smooth streams; some of them are navigable to a considerable distance up the country. There are a variety of other rivers which rise from the hills in different parts of the island, and though they are not navigable, they might be rendered of great advantage in fertilizing the fields.

The internal communications by land through the island have scarcely passed the first stage of improvement. Along the sea coast, indeed, there are roads and stations for travellers; but these in many places are exceedingly steep and rugged. In the other parts of the country footpaths are sometimes discernible, but never any broad beaten way regularly formed, and bounded by walks or ditches. This want of roads gives a striking peculiarity to the aspect of the country, which cannot easily be represented to the mind of a person who has never travelled over a wild and woody region.

In general, the climate of Ceylon is much more temperate than that of India. From Chilauw southward, to Tengalle on the western coast, the air is salubrious and delightful. The medium heat of the thermometer, according to Mr Cordiner, is about 81°, and in the most sultry weather it seldom exceeds 86° in the shade. In the other parts of the coast where the soil is arid and dry, it often indeed rises considerably higher. In general, the heat during the day is nearly the same throughout the whole year; but the variation of temperature between the day and the night is often remarkably great, the thermometer sometimes ranging, in the course of nine hours, from 69° to 99°. The temperate climate of the coast, is doubtless owing, in a considerable degree, to the regular breezes which prevail for a certain number of hours every day. The sea breeze usually sets in about eleven o'clock in the forenoon, and continues to blow till near six in the evening: the land breeze commences about seven, prevails during the night, and gradually dies away towards eight in the morning. In the interior, where the influence of these breezes is not felt, in consequence of the thick and close woods, and the hills which crowd upon each other, the heat is many degrees greater than upon the coast, and the climate often extremely sultry and unhealthy. This inconvenience, however, might be in a great degree obviated, by cutting down the woods, and clearing the jungles, which at present impede the circulation of the cooling breeze.

The lofty range of mountains which runs through the kingdom of Candy, divides the island nearly into two equal parts, and so completely separates them from each other, that the seasons on either side are totally different. These mountains terminate completely the effect of the monsoons, which set in periodically from the opposite sides of the island, so that not only the opposite sea coasts, but the whole country in the interior, suffers very little from these storms. Accordingly, whilst torrents of rain descend on the south and west sides, the north and east experience an unclouded sky, with all the fervid heat of the torrid zone; and when the latter are obscured, the former are again enlivened with uninterrupted sunshine. Indeed it has sometimes been a constant drought on one side of these mountains for several years together, while the other has been deluged with perpetual rains. The monsoons in Ceylon are connected with those on the Coromandel and Malabar coasts, and correspond very nearly with them; but they set in much sooner on the western than the eastern side of the island. On the west side, the rains prevail in the months of May, June, and July, the season when they are felt on the Malabar coast. This monsoon is usually far more violent than the other, being accompanied with dreadful storms of thunder and lightning, together with vast torrents of rain, and violent south-west winds. During its continuance, the variations of the climate are particularly remarkable. The torrents of rain which fall chiefly during the night, render the atmosphere at that time extremely chill and damp, while the excessive heat of the sun by day is almost insupportable. In consequence of the sudden transition from a warm clear day to a cold and wet night, the climate is more unhealthy at this season than during the prevalence of warm dry weather. It is remarkable, however, that these changes affect the negroes and the natives of the continent much more severely than the Europeans.

These monsoons pass slightly over the interior, and do not produce any considerable effect. The seasons in the mountains are regulated by different laws, and do not exactly correspond to either of the monsoons. But this part of the island is not entirely free from the dreadful storms which commit such terrible ravages in tropical climates. There it rains incessantly during the months of March and April, while at that period it is perfectly dry in the low parts of the country: the thunder and lightning are also awful to a degree beyond the conception of a stranger. See Percival's *Account of Ceylon;* Cordiner's *Description of Ceylon*, vol. i.; and *Asiatic Annual Register.*

On this island there are few towns of any considerable importance. In the province of Tallanour is the city of Candy, the capital of the interior, and the chief residence of the prince. It is situated in the midst of lofty mountains, covered with thick jungle. The passes to it are narrow and difficult, and are intersected with thick hedges of thorn. Fences of a similar kind are also drawn round the hills in its vicinity, like so many lines of circumvallation; and through them, the only passage is by gates of the same thorny materials, which are so constructed as to draw up and to fall down by means of ropes connected with them. When the natives are forced to retreat within these barriers, they cut the ropes, and then it is impossible to force a passage unless by burning the gates, which is attended with considerable difficulty and danger, in consequence of the green state of the bushes, and the constant annoyance which the enemy from behind them give the assailants. These hedgerows are the principal fortifications of Candy. The town itself is a poor miserable place, and is surrounded by a mud wall of no strength whatever. It is about two miles in length, and consists of one broad street, with a number of smaller streets, which at different places proceed from it as so many branches. These streets are in general dirty; the houses are poor and mean; they are built chiefly of mud, are thatched with straw and leaves, and have miserably small apertures instead of windows. They are all raised on terraces about five feet above the level of the ground, and there are some stone steps which lead up to every door. A few of the houses at the upper end of the principal street are tiled and white washed. The only buildings of consequence in Candy are some of the temples of Buddhu, and the palace, which is situated at the head of the great street. The latter is built of a kind of cement, which is perfectly white, and is adorned with stone gateways. It is a square of immense extent, but a considerable part of it is not yet completed. In it are a great number of rooms, the walls of which present a multitude of inscriptions, and are painted with the most grotesque figures. Among others, it contains two temples to Buddhu, one Hindoo pagoda, the cemetery of the kings of Candy, and an immense variety of arsenals and storehouses. When the British army entered this city in 1803, they found part of the palace consumed by the flames, the inhabitants having set it on fire before they evacuated the town. However, many of the apartments were still entire, and contained some elegant sets of glass and china-ware, and a few golden cups adorned with filigree. The walls of one of the rooms were completely covered with fine glasses, about seven feet high and four feet broad. Another room, supposed to be the place of private devotion, contained a gigantic brass image of Buddhu in a sitting posture, and two smaller figures of a similar form. Amongst some of the stores was found a profusion of soft paper made of the bark of trees: the sheets were rolled up, and some of them measured twenty feet in length. There was also a vast collection of bows, arrows, and walking sticks, exquisitely painted, displaying a richness of varnish, colouring, and ornament, which probably could not be equalled in Europe. The other principal towns in the interior are Digliggy Neur, and Nilemby Neur, both of which are only a few miles distant from the capital. The ruins of some other cities, which appear to have been larger and better built than any of these, shew that the country was once in a more flourishing condition than it is at present.

Of the European part of the island, Columbo is the capital. It is a large and beautiful town, is built on a regular plan, and much in the European style, though few of the houses are above one story in height. That part of it called the fort, is about a mile and a quarter in circumference; it occupies a situation almost insulated, and is defended by 300 pieces of heavy cannon. This division of the town is inhabited chiefly by the British, the Pettah by the Dutch and Portuguese, and the suburbs by the native Ceylonese. Including all these different classes, Columbo, according to Mr Cordiner, contains upwards of 50,000 inhabitants. There is probably no place in the world where so many different languages are spoken, and which displays such a variety of nations, manners, and religions. Besides the European inhabitants and the proper natives of the island, you find almost every race of Asia: Moors of every class; Malabars, Travancorians, Malays, Hindoos, Gentoos, Chinese, Persians, Arabians, Turks, Maldivians, Javeans, and natives of all the Asiatic isles; Persus, or worshippers of fire, who would sooner allow their houses to be burnt to ashes, and themselves to perish in the flames, than employ any means to extinguish them; together with a number of Africans, Caffres, Buganese, besides the half casts, people of colour, and other races which proceed from a variety of the original ones. Columbo is a place of considerable trade: in 1802, the customs amounted to 19,160*l*. The harbour, however, is difficult of access during a considerable part of the year, and is very insecure for large vessels. The other principal towns in the British territories, are Trincomalee and Point de Galle. The former is one of the most valuable acquisitions on the island, on account of its excellent harbour, which is of incalculable importance to our Indian possessions, as the whole of the Coromandel coast presents nothing but open roads, so that on the approach of the monsoons, all vessels were obliged to stand out to sea to prevent inevitable destruction; and there are also many parts of the coast which could be approached during only a few months of the year, whereas the harbour of Trincomalee now affords them, at all seasons, a near and safe retreat. See *Percival; Cordiner*, vol. i.; *Asiatic Register*, vol. vi.

The soil of Ceylon is, in general, of a sandy nature, with only a small mixture of clay. In the south-west parts, however, particularly about Columbo, there is a considerable quantity of marshy ground, which is exceedingly rich and productive. The ordinary season of sowing in Ceylon, is the months of July and August, and the harvest is about February; but if the land is well supplied with water, the natives do not pay much attention to this, but sow and reap at all seasons of the year. Rice is the principal grain which they cultivate; and as this requires water to grow in during the whole time it stands in the ground, they are at particular pains in procuring a sufficient supply of this necessary article, in making proper conveyances from the rivers and ponds into their lands, and in levelling their corn fields, which must be as smooth as a bowling-green, that the water may completely cover them. By an ingenious contrivance, they are even able to overflow their lands on the hills. For this purpose they level them into narrow allies, from three to eight feet wide, and they surround these with banks, so as to form the appearance of a stair up the declivity. The waters at the top fall into the first alley, and afterwards, by successively running over, one into another, the whole are watered. The instruments which the Ceylonese employ in their husbandry, are rude in the extreme. The plough consists merely of a crooked piece of wood, of such a form that the one end serves for a handle, while the other, (which is shod with iron to prevent the wood from wearing,) tears up the ground. After the first ploughing, the fields are flooded; and when they have lain some time in this state, the water is let off, and they are ploughed a second time The other instruments of the Ceylonese are a board for smoothing their fields, and a piece of wood fastened to the end of a long pole, which serves them in place of a rake. When the season for ploughing arrives, each village makes the operation a common concern; and every one attends with his plough and his oxen till all the fields belonging to the whole society are finished. The same method is employed in reaping the corn; but each person affords provisions to the whole during the time they are cultivating his fields. Oxen are employed both in ploughing and in treading out the corn. This method of separating the rice from the straw is both an easy and an expeditious mode of thrashing grain. It is evident, however, from this sketch of the agriculture of Ceylon, that the country does not produce a crop by any means equal to what, by proper cultivation, it might be made to bear. In consequence of these defects, it does not raise a quantity of rice sufficient for the consumption of the inhabitants, but requires an annual supply from Bengal and other places on the continent of India. The cultivation of this article, however, has been considerably augmented since 1800, and many tracts on the western coast, which were formerly wild and marshy, have been brought into a state of cultivation. See Knox's *Historical Relation of Ceylon. Percival.*

This island is particularly abundant in fruits. Almost all those plants which are peculiar to tropical climates are found in Ceylon in great plenty, and of a superior quality. Most of those fruits which are natives of the island, grow spontaneously in the woods without culture or care; and the only labour necessary is to pluck and bring them to market, where they are of course sold at a very moderate price. Among them are most of those which constitute the greatest delicacies in the deserts of our European tables, such as pine apples, pomegranates, melons, citrons, limes, oranges, almonds, &c. Besides these, Ceylon produces a great variety of valuable and delicious fruits. Among the vegetable productions of this country, cinnamon is the most important. The principal woods or gardens of this tree lie in the neighbourhood of Columbo. They approach within half a mile of the fort, and fill the whole surrounding prospect. The grand garden near the town is so extensive, as to occupy a tract of country from ten to fifteen miles in length, and in this space nature has concentrated all the beauty and the riches of the island. The low cinnamon trees which cover the plain, allow the view to reach the groves of evergreens, which are interspersed with tall clumps, and bounded by extensive ranges of cocoa nuts and other trees. The whole is diversified with small lakes and green marshes, or skirted by fields of rice and pasture. One large road, which proceeds from the west gate of the fort, and returns by the gate on the south, makes a winding circuit of seven miles among the woods. It is here that the gentlemen belonging to the garrison of Columbo take their morning ride, and enjoy one of the finest scenes in nature. The quantity of cinnamon raised on other parts of the island is now very small, unless around Negumbo Caltura, Point de Galle, and Matura. Of late years, little is procured from the interior, and what is brought thence is coarser and thicker in appearance, and of a hot and pungent taste. The internal parts of the country are not so well adapted for the production of this plant; and the exactions and avarice of the Dutch, at length reduced the king of Candy to such desperation, that he resolved to secure himself against their future attacks, by leaving nothing in his dominions which could excite their covetousness. With this view he has, since the [illegible] of the treaty with them in 1766, [illegible] to prevent the [illegible] tree.* In other [illegible] of husbandry in Candy does not [illegible] to be despicable. Mr Cordiner informs us, that all the way from Geeriegamme to the capital, the country is extremely beautiful, and probably in a higher state of cultivation than any part of India. Many of the hills are cleared to the summit, formed into ridges, and sown with grain. The fields below are terraced in the most regular manner on different levels, so that not a drop of water can be lost. The vallies are ornamented with groves of cocoa nut, areka, orange, lime, pimplemose, and plantain tree. See *Percival. Cordiner*, vol. i. *Asiatic Register*, vol. vi. For a more particular account of the vegetable productions of Ceylon, see *Pennant*, vol. i. p. 215—252; *Percival*, p. 312—351; *Cordiner*, vol. i. p. 348—422; and Thunberg's *Travels*, vol. iv.

Ceylon is much celebrated on account of its mineralogy, and particularly for the number and variety of the precious stones which are found upon it. To the class of minerals we may refer the diamond, the ruby, the hyacinth, the agate, the amethyst, the sardonyx, the emerald, the jasper; the tourmaline, red, green, blue, and yellow; the topaz; the sapphire, green and blue; the suphrytus, white, yellow, brown, and black; crystals; cat's eye; and cornelians. All these precious stones occur, particularly in the region round Matura, in the vallies, and at the foot of the mountains, in a compound of earth and fat clay. Several different kinds are found in the same soil, and in the same place. Sometimes they are found likewise on the surface of the earth, where they have been brought down from the mountains by the violence of the currents or rains. The ruby, the topaz, and the diamond of this island, are not, however, so valuable as those of Golconda or the Brazils. The sapphire, aquamarina, and tourmaline, are, on the contrary, equal to those of any other country. Formerly the precious stones were an article of revenue, and were collected by farmers, who contracted for a particular range with government. This plan, however, was for some years given up, as the stones found in the king of Candy's dominions were superior to those of the coast; and the Dutch found it the easiest method of procuring them, to demand from him a certain quantity in the way of tribute. For some time that prince was obliged to comply with the mandates of his imperious neighbours, and sent them a certain proportion of stones every year. Of late, however, he has shaken off this servitude; and, in order to tempt the avarice of Europeans as little as possible, he has prohibited any more from being collected in his dominions. He does not now allow his subjects, on any account, to barter precious stones with Europeans, or to carry any above a certain value out of his territories, under pain of death. It is even dangerous for a Candian to retain any, above a certain value, in his possession, as, by a royal decree, they all belong to the king. Lead and tin are found in the interior; but they are not applied to any useful purpose. There is also abundance of iron stone, the preparation of which constitutes one of the principal manufactures of the natives. They melt it in crucibles over a fire, which is blown with two pair of bellows. They separate the scoriæ with tongs made for the purpose: The melted mass is then poured into a mould of clay; after which it is purified further, and forged for a variety of purposes. There were also several mines of quicksilver wrought by the Dutch; and they have again been opened since the island fell into the hands of the British. See *Thunberg*, vol. iv. *Percival. Knox.*

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* The whole quantity of cinnamon sent annually to England amounts to 4000 bags, or 368,000 lbs. for which the East India Company pay to government a stipulated price of 60,000*l.* sterling.

Among the quadrupeds of this island, the elephant justly holds the highest place. This animal is produced in great numbers in Ceylon, and is superior to those of every other part of the world, with regard to shape, appearance, and docility. In 1797, no fewer than 176 were sent over from this country by Adam's Bridge to the continent of India. Of animals employed for domestic purposes, Ceylon produces but few. The horse and sheep are not natives of this island, and can scarcely be made to thrive even when imported. The former are never employed in servile work, but are chiefly used for drawing gigs, and other light pleasure vehicles of the Europeans. The Indian horses are extremely spirited, and often defend their riders from the attacks of other animals. Captain Percival mentions, that, on one occasion, he was indebted to their prowess for his preservation from the fury of a buffalo. It is only when so vicious as to be perfectly unmanageable, that these animals are ever castrated in this quarter of the world; and in this mutilated state they decrease greatly in value, as they are then by no means so capable of enduring the heat of the climate, and the violent fatigue occasioned by exertion in a warm country. The oxen of Ceylon have a hump on their back, and in size scarcely exceed our calves of a year old. The beef, however, is sometimes tolerably good, and forms the principal food of our European soldiers; and, though these animals are so remarkably small, they are very useful as beasts of burden. The buffalo is also found in great numbers on this island; and, being much larger and stronger than the ox, it is more frequently employed for the latter purpose. Few parts of India produce a greater variety of wild animals than Ceylon; indeed, the forests are extremely dangerous, in consequence of the number of beasts of prey and noxious reptiles which infest them. Many wild animals are also offered to the use of man; and afford subsistence to the tribes who, like them, range the forests. Among these we may mention tygers, leopards, jackals, monkies, porcupines, racoons, armadilloes, the ichneumon, the flying fox, the cobra de capillo, the alligator, deer, hares, wild hogs, and a variety of others. The birds of Ceylon are also a numerous class. The different species of our domestic poultry are natives of this island; and there are few birds found in our woods which do not abound here. The more remarkable birds of Ceylon, are peacocks, parrots, pheasants, the honey bird, the Indian roller, the tailor bird, some of which are found both wild and tame. Many excellent kinds of fish are caught all around the coasts of Ceylon, and form a principal article both of the traffic and of the food of the natives. See *Percival.* For a more particular account of the zoology of Ceylon, see *Pennant*, vol. i.; *Percival*, p. 278—312; *Cordiner*, vol. i. p. 213—248, 422—445; *Knox*, p. 20—32; and *Thunberg*, vol. iv.

In this place we shall introduce some account of the pearl fishery in the bay of Condatchy, which is one of the most important and valuable acquisitions which the British have made on the island. The banks where it is carried on extend several miles along the coast, from Manaar southward of Arippo, Condatchy, and Pompa-rippo. There are fourteen beds, but they are not all productive; and only two or three of them are fished in one season. The principal bank is opposite Condatchy, and lies out at sea about twenty miles; it is about ten miles in length, and two in breadth: the others are much smaller. The depth of water over the different banks varies from three to fifteen fathoms; but the best is in about six or eight fathoms.

The pearl oysters on these banks are all of one species, and of the same regular form; but they are of different qualities and denominations, according to the nature of the ground to which they are attached, and the appearance of the zoophytes which adhere to the outside of the shells. The shape of the oyster is an imperfect oval, pretty nearly the same as that of a cockle, and is about nine inches and a half in circumference. The outside of the shell is smooth, unless when covered with corals, sponges, and other marine productions; the inside is brighter and more beautiful than the pearl itself; the body of the animal is white, fleshy, and glutinous. The pearls are commonly contained in the thickest and most fleshy part of the oyster; they are composed of successive layers, of a substance similar to the shell, and are supposed to be the effect of a disease to which the animal is subject. In general, they are of a bright shining white; but some are occasionally found of a beautiful pink, others of the colour of gold, and a few of a jet black. An oyster commonly contains several pearls; and one has been known to produce 150, including the seed or dust pearls: but, on the contrary, an hundred oysters have been opened without yielding a single pearl which was discernible. The oysters are supposed to attain a complete state of maturity in seven years; after which, it is said, the pearl becomes so large and inconvenient to the fish, that it throws it out of the shell.

Owing to certain disputes in which the Dutch were engaged, this fishery was neglected by them from 1768; but it was resumed by the British government in 1796, after they obtained possession of the coast. The produce of it has varied in different seasons. In 1797, the net proceeds amounted to about 144,000*l.*, and in 1798 it produced a clear revenue of no less than 192,000*l.*; but the banks having been exhausted by the three preceding fisheries, it yielded only 30,000*l.* the following season. The fishery for 1804 was let by government to a native of Jaffanapatam, who, for thirty days fishing with 150 boats, came under an obligation to pay 120,000*l.*; but, as the fishery was very unsuccessful that season, about one-third of the rent was afterwards remitted him.

The fishing season commences in February, and, allowing for interruptions of various kinds, commonly lasts about 30 days. During this time, all the boats regularly sail and return together, with the land and the sea breeze. In each of the boats there are ten divers, who go down into the sea by five at a time, and by their diving alternately, they have time to recruit in the interval. These people are accustomed to dive from their infancy. When one is about to descend, he seizes a rope, to which a large stone is attached, with the toes of his right foot, while he takes hold of a bag of net work with those of his left. Having done this, he seizes another rope with his right hand, and holding his nostrils shut with his left, plunges into the water, and speedily reaches the bottom of the sea, where he collects as many oysters as he can, while he is able to remain under water, which is usually about two minutes. He then makes a signal to the rowers in the boat, by pulling the rope in his right hand, and is immediately drawn up, leaving the stone to be afterwards pulled up by the rope attached to it. The exertion of the divers in this process is so violent, that on getting into the boat, they discharge water from their mouths, ears, and nostrils, and frequently even blood. But this does not prevent them from diving again in their turn. In the course of one day, they often make from 40 to 50 plunges, and at each time bring up about a hundred oysters. Some rub their bodies over with oil, and stuff their ears and noses to prevent the water from entering them, while others use no precaution whatever. They are in general, indeed, under dreadful apprehensions from the sharks, and in order to quiet their fears, the employment of conjurers is a necessary part of the establishment. Two of them are regularly engaged by government. The one goes out in the head pilot's boat, while the other performs certain ceremonies on shore. In these the divers place unlimited confidence; and indeed accidents from sharks rarely occur. Although the usual time of remaining under water does not much exceed two minutes, yet there are instances of some who could remain four and even five minutes: and Mr Beck informs us, in the *Asiatic Researches*, that he saw a Caffre boy remain no less than seven minutes.

Though every precaution is taken to prevent any of the pearls being secreted, the Indians are exceedingly dextrous in making depredations on them. As the boats return to the bay, the oysters frequently open their shells of their own accord; a pearl may thus be easily discovered, and the animal prevented, by the interposition of some small substance, from closing the shell, until a favourable opportunity occurs of secreting the prize. Those fellows who are employed in searching the fish also commit many depredations, and even swallow the pearls to conceal them. When this is suspected, the merchants lock up the rogues, and give them strong emetics or purgatives, which have frequently the effect of discovering the stolen goods. Sometimes also those employed in collecting the pearls agree that one of their number shall act the part of a thief, and bear the punishment of his crime, in order to afford his comrades an opportunity of pilfering. If one of them happens to meet with a large pearl, he makes a sign to his accomplice, who instantly conveys away one of small value, in such a manner as to attract notice. On this the pearl is taken from him, and he is punished for his crime. In the mean time, while he is making a dreadful uproar, his accomplice secures the valuable pearl, and they afterwards share the booty between them.

The pearls found at this fishery are of a whiter colour than those from the Gulf of Ormus, on the Arabian coast; but in other respects they are not accounted of so excellent a quality. The various kinds are sent to different markets. Those of the largest dimensions being most costly, and esteemed emblems of greatness, find a ready sale among the rich natives of the Nizam's dominions, the country of Guzerat, and other parts of India. Those of smaller size are chiefly in demand in England, France, Germany, and Russia, while the refuse find a ready market in China.

The variety of characters, and the display of curious manners, which are seen at this fishery, furnish one of the most interesting scenes which Ceylon presents. Parties of strolling jugglers, tumblers, dancers, mendicants, mechanics of every description, retailers in every branch of commerce, even from the remotest parts of India, resort to Condatchy, during the season of the pearl fishery, in the hope of acquiring some share of the transient stream of wealth which flows periodically through its barren plains. See *Asiatic Researches*, vol. v. 393—411. *Cordiner*, vol. ii. *Percival.*

With regard to the population of this country, we do not possess any authentic accounts, but as it is so much in a state of nature, we may conclude that the inhabitants are not very numerous. Mr Cordiner estimates them at 1,500,000; but this calculation rests on no certain data. Besides the Dutch and British inhabitants, there is a numerous race, known by the name of Portuguese, who are the spurious descendants of that people by native women. We also find a vast number of Malays, who, indeed, are scattered over most of the islands in the Indian Ocean, and are a remarkably ferocious race, and very peculiar in their manners. These various classes have settled on the coasts of Ceylon, for the purposes of conquest or of commerce; but by far the greater proportion of the inhabitants consist of Ceylonese, which is the general name of the natives of the island. To distinguish them more particularly, those under the dominion of the British government retain the original appellation, Cingalese; while the inhabitants of the interior, who are subject to the authority of the native prince, receive the name of Candians. The constant intercourse of the Cingalese with Europeans, and the aversion which the Candians have always expressed for their invaders, have introduced considerable shades of difference into the character and manners of these two branches of the same people. In most parts, however, they still continue to resemble each other, so that one description may, in general, apply to both.

The following character is drawn of them by Mr Knox, who was a Captain among them for nearly twenty years: "In short," says he, "in carriage and behaviour, they are very grave and stately; in understanding, quick and apprehensive; in danger, subtile and crafty; in discourse, courteous, but full of flatteries; naturally inclined to temperance, both in meat and drink, but not to chastity; near and provident in their families; commending good husbandry. In their dispositions not passionate, neither hard to be reconciled again when angry. In their promises very unfaithful, approving lying in themselves, but misliking it in others; delighting in sloth, deferring labour till urgent necessity constrains them; neat in apparel, nice in eating, and not given to much sleep." The Ceylonese, in general, are of a middling stature, and fairer in complexion than the natives of India. According to Mr Cordiner, the Cingalese are indolent, harmless, and unwarlike, remarkable for equanimity, mildness, bashfulness, and timidity: the Candians are a bold, active, and hardy race. This diversity of character naturally arises from the difference of circumstances in which they have been placed.

The Ceylonese, like the Hindoos, are divided into a number of casts. Captain Percival mentions only four; but Mr Cordiner enumerates nineteen, according to the several occupations of the people. The highest comprises the nobles, and next to them are the superior classes of artificers, as painters, goldsmiths, smiths, and carpenters. All the different casts, according to the Indian custom, are careful not to intermingle together. The son pursues the profession of his father from generation to generation, nor is one cast allowed to interfere with another. The principal external distinctions of the higher and lower casts consist in wearing doublets, or going barebacked without them; the length of the cloth below their knees; their sitting on stools, or on mats spread upon the ground, and in the caps which they wear. But besides the regular casts there is a wretched class of mortals, the martyrs from age to age of this unnatural and barbarous institution. Those who by any crime or act of negligence forfeit their cast, are not only condemned to infamy themselves, but their descendants are involved in the awful consequences of their guilt. They are not allowed to exercise any trade or profession, but are obliged to beg for daily sustenance; and thus, age after age, become a dead weight upon society. At the same time, they have to pay the lowest of the other natives as much respect and reverence as the latter shew to the king.

The houses of the Ceylonese are small and low, consisting only of one story. They are constructed of slender pieces of wood or bamboo, daubed over with clay, and covered with rice straw, or the leaves of the cocoa tree. Round the walls of these huts are small banks of clay, on which they sit or sleep. These benches, as well as the floors of their houses, they overlay with cow-dung, in order to preserve them from vermin, and to keep them smooth and clean. The furniture of their cottages is of the most simple kind, and consists merely of a few instruments, indispensably necessary for the preparation of their victuals. The Ceylonese use neither tables, chairs, nor spoons; but, like other Indians, place themselves on the ground, and eat their food with their hands. The houses of the Candians are much superior to those of the Cingalese; for although the latter are accustomed to see better models, yet the abject state to which they have been reduced under the tyranny of the Portuguese and Dutch, has retarded their progress in improvement. Their villages, instead of presenting the regular compact appearance of a town, look like a number of miserable huts scattered through the midst of a thick forest. There is not the smallest regularity observable among them; but every individual places his cottage near the centre of a cocoa tree tope, in the most convenient spot he can find. In the mountainous parts of the country, where the natives live in continual danger of attack from wild beasts, of being annoyed by serpents, or suddenly overtaken by inundations, it is usual for them to build their huts on the summit of rocks, or even on the top of lofty trees. Some of them also fix a number of high posts in the ground, and place on these a kind of hurdle, which serves them for a nocturnal habitation.

In their dress, the Ceylonese are remarkably simple. That of the lower ranks of men consists merely of a piece of coarse cloth wrapped round their loins, and covering their thighs, or frequently only the parts which decency requires to be concealed; that of the women is similar, but only longer, and they also wear a short jacket, which usually covers their breasts and shoulders, leaving the middle of the back bare. The higher ranks cover the whole of their bodies; they are fond of ornaments, and the dress of many of them bears some general resemblance to that of Europeans.

In their diet the Ceylonese are remarkably temperate. The principal part of their food consists of fruits and rice. Flesh is seldom used by them; but in some places where fish abounds, they employ them as a portion of their meals. In dressing their victuals, the Ceylonese are scrupulously nice; and, in drinking, they are careful not to touch the vessel with their lips, but hold it at some distance over their head, and pour the liquor down their throat. All ranks among them chew the betel leaf; this is the desert at all their entertainments, and the usual supplement to all their conversation. Along with it they mix tobacco, areka nut, and the lime of burnt shells, in order to render it more pungent. When chewed, this mixture becomes red as blood, and stains the mouth, lips, and teeth, of an indelible black colour. This they think a beautiful effect, for they consider white teeth as only fit for dogs, and a disgrace to the human species. This hot mixture, however, soon destroys their teeth, and often renders them toothless at an early age. There is a wonderful degree of gravity observed among the Ceylonese in company, even among relatives and intimate friends. At meals they seldom converse with each other; and it is not unusual to see a party sit perfectly mute for a long time, and during all the while chewing the betel leaf.

The Ceylonese are courteous and polite in their manners, to a degree far exceeding their civilization, and greatly superior to other classes of Indians. In their salutations they are particularly punctilious. The form which they use is that common in the East, of bringing the palm of the hand to the forehead, and then making a low bow. However, though in general courteous and polite, if their anger is once roused, it is proportionally furious and lasting. Their hatred is so violent, that they often destroy themselves to obtain the destruction of the detested object. A Ceylonese has been known to kill himself in the company of his enemy, that the latter might suffer for it.

The Ceylonese are of a remarkable dissolute character. It is common for the men to indulge in promiscuous intercourse with the female sex; while the infringement of the laws of chastity on the part of a woman, scarcely subjects her, even though married, to the slightest reproach, unless, indeed, it happens to be with one of an inferior cast; an act which is considered as the very excess of infamy. Among people of the same rank, the most unbounded commerce is carried on in private; and it is by no means uncommon, nor attended with any disgrace, for the nearest relations to have connection with each other. The Ceylonese are particularly fond of forming a correspondence with Europeans; and, instead of accounting it any reproach, a mother, in quarrelling with any of her neighbours, will silence them at once with regard to her superior dignity, by telling them, that her daughter has had the honour to receive the favours of an European.

Though in Ceylon the men are not limited to one wife, yet in consequence of the ease with which promiscuous intercourse is carried on, and the facility with which marriages are dissolved, together with the poverty of the natives, polygamy is not general among them. Indeed, this is so far from being the case, that it is not unusual, particularly for brothers, to have one woman in common. In general, the contract of marriage is originally made by the parents while the parties are in a state of childhood; and it is often dissolved by mutual consent, almost as soon as it is consummated. It is also customary for those who intend to marry, previously to cohabit together, and to make trial of each other's temper, and if they do not agree, they break off the connection without any further ceremony. In this case, no disgrace attaches to either party, but the woman is held in as high esteem by her next lover as if he had found her in a state of virginity. If, however, the parties agree to marry, the man presents the bride with the wedding clothes, which consist only of a piece of cloth about six or seven yards in length, and with another cloth which is placed on the bed. On the following night he is entitled to sleep with her; and on this occasion they fix the time for the celebration of their nuptials. When the day arrives, the bridegroom and his relations repair to the house of the bride, carrying along with them what they are able to contribute for the marriage feast. The parties then eat out of one dish, to denote that they are of the same cast; after this their thumbs are tied together; and the ceremony concludes by the nearest relations, or the priest when present, cutting them asunder. This form, however, is scarcely considered as obligatory. When the Ceylonese wish to render a marriage as firm and indissoluble as the nature of their manners will admit of, the parties are joined together with a long piece of cloth, folded several times round both their bodies, and water is then poured on them by the priest, who always officiates at this ceremony. After the marriage, the young couple pass the night at the bride's house, and in the morning the husband takes her home, accompanied by her friends, who carry with them provisions for another feast. The dowry of the wife is in proportion to the ability of the parents; but if they afterwards separate, it returns with her, that she may be as good a match for her next husband. Both men and women often divorce several times, before they find a partner with whom they can reconcile themselves to spend their days. If they have children when they separate, the common law is, that the sons remain with their father, and the daughters go with their mother. Indeed, they often have no family, as the practice of infanticide is common in Ceylon. As soon as an infant is born, the father applies to an astrologer to know whether it is in a good or an evil hour. If it is found to be the latter, they immediately destroy it, either by starving it to death, by drowning it, or by burying it alive; or else they give it to some person of the same rank with themselves, for they say the child will be unhappy only to the parents. In general, the women of Ceylon are much more pleasant and agreeable than those in the other parts of India; but owing to their early intercourse with the other sex, (for they are regularly married when about twelve,) they soon lose the appearance of youth, and become old and haggard in their looks immediately after they pass twenty.

The Ceylonese, according to Mr Knox, are of a healthy constitution, and many of them live to the age of fourscore and upwards. During the wet season, however, they are subject to a variety of diseases, particularly fevers and fluxes. Leprosy appears to be very prevalent among them, and the streets of Columbo swarm with Cingalese beggars labouring under this dreadful disorder. But the disease which particularly excites their apprehensions is the small-pox. It is looked upon as the immediate instrument of divine vengeance, and therefore they employ no charms or incantations for the recovery of those who are so unhappy as to labour under it. If any one die of this disorder, he is thought to be accursed by God, and therefore they deny his body the common rites of burial.

The reports of the progress of vaccination in Ceylon are peculiarly interesting, as they place in the strongest light the success of that practice. The ravages which the small-pox formerly made in this island were dreadful; but in 1802, the progress of that destructive malady was happily checked, by the introduction of the cow-pox; and from that period till the beginning of 1810, the number of persons vaccinated, amounted to 128,732, of whom there were no fewer than 25,697 in the course of the preceding year, besides some others inoculated by private individuals. Indeed, so completely effectual had the practice proved, that, according to the best information, the small-pox had not appeared in any part of the island from February 1808 to October 1809, a period of not less than 20 months. It was then, indeed, introduced at Jaffanapatam, by a country boat from Quilon on the Malabar coast; but it attacked only a few individuals who happened not to have been inoculated. We have here, therefore, a striking proof of the beneficial effects of general vaccination. Contagion may be introduced into a country, but it dies for want of susceptible subjects: a fire-brand may be applied, but there is no fuel to produce a conflagration.

In ordinary cases, the higher ranks burn the dead; but the inferior casts bury them without any particular ceremony. The house in which a person dies is always deserted for some months, or even for ever. The water of the sea is considered as the best for purifying such a place; but when this cannot be had, they use the water of a stream, cowdung, and curcuma. In order, however, to avoid this inconvenience and trouble, they sometimes have recourse to the following cruel practice. When the relations of a sick person despair of his recovery, they take him into a wood, in spite of his cries and groans, and there leave him perhaps in the agonies of death. It sometimes happens that people thus left recover and return to their families, without, it is said, entertaining the smallest resentment against their unfeeling relations. This atrocious practice is particularly common in the poorer provinces of the kingdom of Candy. See *Percival. Knox. Cordiner*, vol. i. *Asiatic Researches*, vol. vii.

But besides the Ceylonese, there is a singular class of people in this country called Bedahs, who inhabit the deepest recesses of the forests, and whose origin has never yet been traced. They are scattered over the woods in different parts of the island; but are most numerous in the province of Bintan, which lies to the north-east of Candy, in the direction of Trincomalee and Batacolo. This singular people subsist entirely by hunting deer and other animals, with which the forests supply them, and on the fruits which spontaneously grow around them. They seem to have no houses, for they usually sleep either on the branches or at the foot of trees. In the latter case, they surround them with thorns and other bushes, to keep off wild beasts, or by their rustling to give warning of their approach; and if the smallest noise rouses the apprehensions of the Bedah, he climbs up the tree with the utmost expertness and celerity. Though they do not acknowledge the sovereignty of the king, yet once a-year they send two deputies with honey and other little presents to him. On their arrival at the gate of the palace, they send word to his majesty, that his cousins wish to see him. They are immediately introduced, kneel before him, then get up, and enquire familiarly about his health. The king receives them well, accepts of their presents, gives them others, and orders that certain marks of respect be shewn to them on their return from the palace. Those of the Bedahs who skirt the European territories, barter the natural productions of the forests with the Cingalese for the few articles which their simple mode of life requires; but in order to prevent themselves from being surprised or made prisoners while carrying on this traffic, they employ a curious method. When they are in want of cloth, iron, knives, or any articles of smith-work, they approach some village during the night, and deposit, in a place where it is likely to be immediately discovered, a certain quantity of their goods, along with a talipot leaf, expressive of what they wish in return. On a following night they repair again to the same place, and generally find the expected reward awaiting them; for although they are easily satisfied, and readily allow the advantage to the person with whom they deal, yet if their request is treated with neglect, they do not fail to watch an opportunity of doing him mischief. The Cingalese, as they can afterwards dispose of the articles afforded by the Bedahs, find the traffic profitable; and in some places they even go into the woods, carrying with them articles of barter. The dogs of the Bedahs are remarkable for their sagacity, and not only readily trace out game, but also distinguish one species of animal from another. On the approach of any carnivorous animal, or of a stranger, they immediately put their masters upon their guard. These faithful creatures are, indeed, invaluable to them, and constitute their chief riches. When their daughters are married, hunting dogs form their chief portion; and a Bedah is as unwilling to part with his dog, as an Arabian with his horse. See *Percival. Asiatic Researches*, vol. vii

The learning of the Ceylonese consists chiefly in some pretensions to skill in astrology. It appears, however, that they were formerly possessed of some literature, and had attained some refinement in the arts. Their language consists of two dialects, which differ considerably from each other, and have separate grammars. To read and write are no ordinary accomplishments among the natives of Ceylon. In Candy, they are chiefly confined to the learned men of the sect called Goeries, who are retained by the king to execute all the writings of state, and those which relate to matters of religion. The Arabic is the character which they employ on these occasions. In writing, they commonly employ, instead of paper, the leaf of the talipot tree. From these leaves, which are of an immense size, they cut out slips from a foot to a foot and a half long, and about a couple of inches broad. Having smoothed the slips, and taken off any excrescences with a knife, they are ready for use without any further preparation. In writing, they employ a fine-pointed steel pencil, set in a wooden or ivory handle, for engraving the characters on the talipot leaf, which is very thick and tough: and in order to render the letters more visible and distinct, they afterwards rub them over with oil mixed with charcoal powder, which has the effect of rendering them so permanent that they cannot then be effaced. If one slip is not sufficient to contain all they wish to write on any particular occasion, they string several together with a bit of cord, and attach them to a piece of board, in the same way as we file newspapers. Sometimes these talipot books are richly ornamented, and bound in thin lacquered boards of ivory, or even silver and gold. In the dispatches which were sent by the king to the Dutch government, the monarch seemed particularly anxious to display his magnificence in the splendour and richness with which they were executed. The writing was inclosed in leaves of beaten gold, in the shape of a cocoa-tree leaf. This was rolled up in a cover richly ornamented, and almost concealed in a profusion of pearls and precious stones. The whole was enclosed in a box of silver or ivory, which was sealed with the emperor's great seal. The same splendour has been observed in the letters sent to our governor, since we have had possession of the island. See *Percival.*

Of the religion of the Ceylonese we have very imperfect and contradictory accounts. They acknowledge the existence of one Supreme Being, the Creator and Governor of the world, but they have also a number of inferior deities and evil demons. Of the former, the most exalted is Buddhu, whom some represent as originally a divine person, and others as the spirit of a good man crowned with divine honours. He is said to have appeared in the world in the form of a man, and after having performed a vast number of virtuous actions, and been transformed into a great variety of shapes, he ascended again into heaven, where he acts as a mediator with the Supreme Being, and procures the pardon of his worshippers. The Ceylonese dedicate no temples to the Supreme Being; but those of Buddhu are superior to those of all the other deities. They have no certain form, as they are generally built in the caves of rocks, and it depends on the particular nature of the cave, whether the statue of Buddhu is standing, or sitting with its legs across, or lying upon its right side. This figure is invariably yellow from the head to the feet, and a large garment of the same colour covers the whole body except the right breast. On one side of the temple there is always a monument in the form of a cupola, placed on a moulded pedestal, which is said to contain a particle of the bones of Buddhu. Captain Percival mentions, that the ruins of the temples and pagodas which he saw in the interior of the country were all of hewn stone, and of much superior workmanship to those on the coast. Several of them were in a state of perfect preservation, and, on comparison with the modern structures, afford the strongest proof that the inhabitants of this country had formerly attained a much higher degree of improvement than at present appears among them. As the temples of Buddhu are superior to those of the other deities, so the priests of that god are held in the highest estimation, and are endowed with a variety of peculiar privileges. They are chosen by the king from the body of nobles, and in consequence of their birth, they are generally men possessed of power and influence, independent of their sacred character. Though they are chosen by the sovereign, he retains no authority over them, but endeavours to cultivate their regard, by respecting their privileges, and loading them with favours. They choose their own superiors, and the chief priest is invested with the power of settling all religious disputes. They have also the chief management of public affairs, and are exempted from the payment of all taxes. The highest honours are paid them by the rest of the nation. All ranks bow down before them; when they sit, their seats are covered with a white cloth, and when they walk, the broad end of the talipot leaf is borne before them;—privileges which, in Ceylon, are of the highest kind, and shared with them only by the monarch. But while the priests enjoy these and other honours, they are also placed under certain restrictions. They are not allowed to marry, and they are also prohibited the use of wine and animal food. They have an opportunity, however, of escaping from these restraints, as they are allowed to lay aside their order whenever it suits their inclination. The temples dedicated to the other deities are much inferior to those of Buddhu. In general, they are poor, mean, contemptible huts of one story high, without windows, constructed of clay and wood, and covered with cocoa-nut leaves. There is no figure too ridiculous to find a place in them; besides swammies of all descriptions, there are representations of wild beasts, birds, pieces of consecrated armour, and some very indecent figures of men and women. The priests of the inferior deities, though dressed like those of Buddhu, may easily be distinguished by the smaller degree of respect which is paid to them. They are continually met in their wandering excursions over the island, and like all those of the same class in India, are a set of lazy, impudent vagabonds, who, without any exertion or industry, are enabled to live comfortably by the extortions which they practise upon the people. But though the Ceylonese worship these various deities, the chief objects of their fear are the subordinate demons, whom they consider as the spirits of wicked men. These impress their mind with much greater awe than the more powerful divinities who dispense blessings among them. They, indeed, think that their country is in a particular manner delivered over to the dominion of evil spirits. There is no people who labour so much under the influence of superstitious fear as the Ceylonese. Omens regulate the whole of their conduct, and even decide upon their destiny from their birth. The Mahavellaganga is said, by Mr Cordiner, to be held in the same religious veneration by the Ceylonese as the Ganges by the inhabitants of Bengal. The water of this river is considered as effectual in washing away sin; but dead bodies are never thrown into it. The immortality of the soul, and the resurrection of the body, are doctrines generally believed among the Ceylonese. They suppose that the souls of the just are immediately after death admitted into the rank of gods, and that their ancient prophets and good kings are long since employed in exercising the power of deities: while, on the other hand, the souls of the wicked, particularly of unjust tyrants and impious priests, are supposed to have passed into wild beasts and reptiles. The Ceylonese are very liberal in the distribution of charity. It is customary for them even to appropriate a certain portion of their food for distribution among the poor; and although among the Hindoos, strangers in distress are accounted objects of very little compassion, yet a Cingalese will not shut his house against a Malabar or Moor who asks him for relief.

Such is a slight sketch of the system of Paganism professed in Ceylon. Christianity, however, has been established on the island for three centuries past. The Portuguese, when they first settled on the coast, introduced the Catholic religion among the Cingalese, and subjected them to the yoke of the church of Rome. Afterwards, the Dutch introduced the doctrine of the Reformation, and propagated the profession of them among the natives. Indeed, if the number of converts be any proof of success, in no country has Christianity been so successful, in modern times, as in Ceylon. Both the Catholics and the Protestants, boast of hundreds of thousands among the natives whom they called Christians; but we regret to add, that most of them had no claim to the title, for though they had been baptized in the name of Christ, they were still worshippers of the idol Buddhu. So late as 1801, we are informed that the number of native Protestant Christians on the island was upwards of 342,000; and that it was supposed the Roman Catholics were still more numerous. At the same period, the number of native schools amounted to about 170; but shortly after, the most of them were suppressed by the ill-judged parsimony of the Court of St James's, though the whole saving to government scarcely amounted to the paltry sum of 1800*l.*!

The government of Candy is an absolute despotism; but notwithstanding this, the natives look upon certain fundamental laws and regulations existing among them from time immemorial, as the real depository of power; and they maintain, that if the king encroach upon these, he is amenable to the justice of his country as well as the meanest subject. It is evident, however, that while there is no power to balance that of the sovereign, it is only a successful rebellion that can bring him to justice. The monarchy of Ceylon is completely elective, according to the fundamental laws of the kingdom; and when a deposition takes place, this principle is usually acted upon. It is in the power of the people to put aside the next branch of the royal family, and to elect a distant relation, or even a perfect stranger. If the last king has no immediate descendants, and the hereditary right lies equally between males and females, the preference, according to the Candian laws, is given to the female branch of the family.

The king of Candy yields to no eastern prince in the number and extravagance of his titles, and in the reverence which is shewn him by his subjects. No one dare approach him without prostrating himself three several times before the throne, and each time repeating a long string of his majesty's titles. No one, even of the highest rank, is allowed to cough or spit in his presence; every one is silent before him, nor does any one, even in a whisper, venture to address one another. The prime minister is the only person who is allowed to stand in the royal presence, and even he is obliged to be some steps lower than his majesty, as no one must appear on a level with him who is supposed to be descended from the sun. The business of state is transacted between the king and the prime minister in low whispers; and any message from his majesty to those present, is conveyed in the same manner by the adigars.

The highest officers of state are the adigars or prime ministers. They are two in number, and actually share all the power of the court between them. The officers next in rank are the dessauvas, who are the governors of the corles, or districts, into which the kingdom is divided, and they are also the principal military commanders. The whole plans of government form a regular system of oppression, which falls with peculiar severity on the lower orders of the people. Few have the courage to appeal against the unjust extortions of the higher ranks, and fewer still meet with any redress. They have long since been stript of every thing valuable, and many of them trust for subsistence to the spontaneous productions of their forests, rather than cultivate fields, whose produce must be shared with their oppressors.

The principal revenues of the king consist of presents or contributions brought him by the people, or rather forced from them by his officers. They consist of money, precious stones, ivory, cloth, corn, fruit, honey, wax, arms, and other articles of their own manufacture, such as spears, arrows, pikes, targets, &c. The lower classes, however, are not the only persons who feel the burden of supplying the royal treasury. On certain festivals, which the king observes in great state, all the nobles and principal people are obliged to appear before him, and none of them must come without a present. It is dangerous for them to keep back on these occasions, and a liberal gift is necessary for the preservation both of their persons and their property. But these stated contributions are not the only kind of extortions practised in Candy to fill the royal treasury. The moment that the king's officers understand that any one is possessed of valuable articles, they demand a share of them for the sovereign. Artists are likewise frequently employed by the prince to make him arms and different works in gold and silver at their own expense.

As the government of Candy is completely despotic, every subject, without distinction, must be ready at the call of the sovereign. His regular troops, Captain Percival estimates at about 20,000; but these, though called regulars, have neither arms nor clothes to entitle them to that appellation. They wear whatever dress they choose, and arm themselves with any kind of weapons they can procure, as spears, pikes, swords, targets, bows and arrows, muskets and bayonets, so that altogether they have a very motley appearance. Besides those that are considered as regular troops, the king has a numerous militia scattered over the country, and his guard, like that of despots in general, is composed entirely of foreigners.

A few years before this island fell into the hands of the British, the Dutch introduced new regulations in the management of the finances of the settlement, in consequence of which its income was greatly augmented, while the expences were diminished, as appears from the following statement:—

	Income.	Expences.
In 1787, . .	823,362	823,362 Florins.
1791, .	1,345,761	794,755

For some years after the Dutch possessions on this island fell into the hands of the British, they were placed under the management of the East India Company; but from the beginning of 1802, they became a royal government, and were placed under the immediate direction of his majesty's ministers, who now regulate the affairs of the settlement. The Cingalese, who live under the British government, are now subjected to our laws, and to our form of administering justice, except in a few points in which their ancient customs are retained. They are governed by their native magistrates, but the supreme controuling powers always reside in the servants of his majesty. According to the report of the Dutch board of trade, the revenue of Ceylon was formerly able to defray their expenditure on account of the island; but of late years the expenditure had far exceeded the produce of the revenue. In 1795 it amounted only to 611,704 livres, while the charges of the established government were upwards of double that sum, amounting to 1,243,338 livres, or 57,934*l.* sterling.—Though the revenues of Ceylon are now much greater than under the Dutch administration, yet they are not sufficient to defray the expence of our various establishments on the island. Captain Percival, indeed, estimates them at 1,200,000*l.*; but Mr Cordiner informs us that this must be a great mistake, and that at present they do not exceed 226,600*l.*, while the ordinary expenditure of the island amounts to 330,000*l*, so that the loss to government amounts to no less than 103,400*l.* In this state of the revenue, he says, every source is included, allowing 60,000*l.* from the East India Company on account of cinnamon, and 40,000*l.* as the average produce of the pearl fisheries, though we apprehend the estimate of the latter is too low. See *Percival. Cordiner. Edinburgh Medical and Surgical Journal*, vol. vii. p. 254, *Fabricii lux Evangelii per totam orbem exorcens. Transactions of the Missionary Society*, vol. ii. and iii. *Martyn's Christian India, a Sermon preached at Calcutta, January* 1, 1811. (W. B.)

CHAFF-Cutter, is a machine for cutting hay and straw into short lengths for cattle.

The machine for cutting chaff, which has been long in use, consists of a plane box or trough, mounted on four legs to support it, and across the end of the box, a large knife or blade is worked by means of a handle fixed to one end of it. The other end of the knife is jointed to a lever, which moves on a centre at the bottom of one of the legs, so that when the knife is worked, one end describes the arch of a circle, while the other is applied by the handle to the end of the trough or box; and the straw being placed in it, the end of the straw which projects beyond the extremity of the box, is cut off by the knife when worked in an inclined position, and with a drawing or thrusting stroke, which causes it to cut very clean. The workman depresses the knife with his right hand, whilst his left is employed in making the straw advance in the box, every time a cut has been made. This he does by a fork with a wooden handle, and four or five prongs, which are stuck into the straw. At the time when the cut is made, a treadle is pressed down by the foot, which draws a piece of wood down upon the straw in the box, and thus compresses it so closely, that the knife cuts much better than if it had been loose.

From the difficulty of using this implement with any rapidity, the farmer employs a man who makes a business of cutting straw, and travels from one farm to the next with his chaff-box at his back.

Mr R. Salmon of Woborn, Bedfordshire, has invented the most complete chaff machine which has yet been produced: it is represented in Plate CXXXV. Fig. 1. in which AA, BB, are two cast-iron wheels, connected together by bolts *a*, *a*, extending from the rim of one wheel to that of the other. The wheels are mounted on an axis C, which is supported on bearings in a proper framing, as is evident from the figure. The straw is put into a box or trough GF, and what projects beyond the end thereof is cut off by two knives *b*, *b*, attached to the insides of the rims of the two wheels AA, BB, which are turned round by the winch handle E; or where there is a thrashing or flour-mill, an endless rope may be conducted round the pulley or rigger D, and thus give it motion without any trouble. The knives *b*, *b* are placed at an angle of 45 degrees to the direction of the wheel's motion. They are attached to the wheels by iron rods or levers C, moveable on a centre-pin, and capable of being forced forwards towards the chaff-box by springs, which are formed to adjust by screws *h*, and act more or less as occasion may require, so as to give the knife as much pressure against the end of the box as may be requisite to cut the straw. The knives are prevented from coming too far forward, and occasion unnecessary friction, by the wedges under the staples near C; which wedges, as the knives wear, must be drawn out so as to permit the knives to come more forward. With the provision before mentioned, it will be found very easy at any time to put in new knives, as the springs and levers will always adjust them to their work.

On one side of the wheel is fixed a round block of wood *f*, in which there are four holes and a moveable screw, acting as a crank, upon one end of the feeding arm *f*, *g*, extending nearly horizontal to the cross lever LM, Fig. 2, to which the end of *g* is attached by a pin. The straw is brought forward by a pair of rollers in the box E, the form of which is shewn at *m m*, in Figs. 2, 4, and 5, which rollers are turned from the outside by ratchet wheels H, on each side of the box F. The ratchet-wheels are provided with clicks, as shewn in Fig. 2, which are actuated by means of small rods *r r*, Fig. 3, extending from each click, and jointed to the cross lever LM, which moves upon a centre-pin *c*, fixed beneath in the bottom of the box F; by this means, the rods *r*, in moving either way, by actuating one or other of the clicks, turn the ratchet-wheels and rollers round a proper quantity, to advance the straw forwards; but this quantity can be regulated at pleasure, according to the stroke given to the cross lever LM, by the feeding arm *f g*, and crank: The pin which attaches the end *g* of the feeding arm to the cross lever L, is moveable to five different holes in L; by means of which, and the four holes in the block *f*, before described, for the crank-pin, twenty changes in the length of the chaff may be obtained. By this mode of feeding, the straw is perfectly at rest, and does not press forward at the time of the cutting; at the same time, lifting up the feeding arm, its end is disengaged from the pin fixed at the end of the cross-lever, and the feeding motion is instantly thrown off, although the wheel and knives may continue thei motions.

Beneath the box is suspended the pressing-weight R which may be made more or less powerful by shifting the weight on the lever from which it hangs; and i also may be thrown on either side, more or less, as occasion may require; which will be found useful, in forcing the straw towards the knife, and counterbalancing the ratchet-wheel of the upper roller. The arbor of thi lever carries two short levers, one of which is shewn at *r*, Fig. 1. From these, iron rods proceed to the pivots at the ends of the upper spiked rollers, by which means the straw is always equally pressed in passing the two spiked rollers. Great advantage is obtained in this machine, from its cutting various lengths—from its resting during the cut—from the knives being adjusted to work by their regulating springs—from the feeding being readily thrown off—and from the pressure being moveable to either side of the box. In consequence of the knives acting against the end of the box, which is covered with steel-plate, they are constantly kept sharp.

Figs. 6, 7, and 8, are figures of a chaff-cutting machine, which, under a variety of forms, has come into very general use. The original was constructed by M James Pike, who presented one to the Society of Arts many years ago. It has received successive improvements from Messrs Cook, Nailer, Winlaw, Macdougal and other implement makers, till it obtained the form given in Plate CXXXV. Fig. 6 is a front, and Fig. 7 a side elevation; in which AAA is a cast-iron fly-wheel, with three curved arms, extending from its centre to the circumference; and against these, 3 knives *b b b* are screwed and adjusted by wedges behind, to apply fairly against the end of the box D, in which the straw or hay is spread evenly and regularly. The spindle *a*, Fig. 7, of the wheel is supported in bearings at each end, one being screwed to the side of the chaff-box, and the other fixed upon a post H, which is attached to the frame K by blocks, and secured to it by braces I; so that it is very firm and secure at a proper distance from the frame K The axis *a* has a worm, or endless screw, formed upon it, which actuates the teeth of a wheel F, fastened upon the end of the spindle of the lower roller in the chaff-box. The upper roller is supported in a frame of iron *e f*, shewn separately in Fig. 8. This is attached to the box by centre pins at *e e*, and the arms *e f*, *e f*, proceed to the branches which carry the pivots of the roller *g* A bar *f f* unites the two sides of the frame; and upon this a short lever operates to press down the whole frame, and thus hold the roller down forcibly upon the straw, and press it between it and the lower roller, so that it will be moved forward when the rollers are turned round by the motion communicated to the worm-wheel of the lower roller. The upper roller is moved by a contrate wheel *l*, on the extremity of its spindle, which is turned round by a long upright pinion *m*; and this receives its motion by means of a similar contrate wheel *l* from the lower roller. By this means the upper roller is always kept in motion, let it rise as high as it will, in consequence of a great feed of straw being introduced between the two. The short lever, which, as before stated, depresses the upper roller and frame *e f*, is fixed upon an axis *d*; on the end of which, a lever *d c* is fastened, and loaded at pleasure by a moveable weight *c*, which, like a steelyard, can be shifted at pleasure, to increase the pressure upon the straw. A piece of wood *h*, Fig. 8, is attached to the iron frame *e f*, and pressed down upon the straw, just before the place where the knife cuts the straw. The whole is turned round by one man working a handle B, fastened on the end of the main axis; and it is stated by the inventor, that twenty-two bushels can be cut in an hour by this machine with one man. The rollers which advance the straw, have diagonal ribs of iron projecting from them, as shewn at *g*, Fig. 8, which hold the straw fast; and the lower roller has the same.

This machine is of small size, and being sold at a low price, is very generally adopted; but the action is not by any means so good as that of the machine of Mr Salmon; and the rollers acting to advance the straw forwards all the time during the cut, causes a great friction on the back of the knives. Mr Passmore of Doncaster makes machines on Mr Salmon's plan, of a small size, in cast iron, which are cheap and effective: And Mr Braby of London has produced a simple machine, which is the old chaff-box provided with rollers to advance the straw; and these are turned round by a ratchet-wheel, which is moved every time the knife is raised up to make a fresh stroke, and thus the straw stands still during the cut. (J. F.)

CHÆROPHYLLUM, a genus of plants of the class Pentandria, and order Digynia. See BOTANY, p. 154.

CHÆTANTHERA, a genus of plants of the class Syngenesia, and order Polygamia Superflua. See BOTANY, p. 305.

CHÆTANTHUS, a genus of plants of the class Diœcia, and order Triandria. See BOTANY, p. 334.

CHÆTODON. See ICHTHYOLOGY.

CHÆTOSPORA, a genus of plants of the class Triandria, and order Monogynia. See BOTANY, p. 107; and R. Brown's *Prodromus Plant. Nov. Holl.* &c. p. 232.

CHAGAING, a city of the Birman empire, situated on the north bank of the Irawaddy, at the foot and on the side of a rugged hill, crowned with numerous eminences. A white washed spiral temple stands on each of these summits, and produces a very picturesque effect. The images of the god Gaudma are manufactured here, from fine marble obtained from a quarry of Maengaing; and from this cause, as well as from the number of temples built in its neighbourhood, Chagaing has become a place of religious resort. N. Lat. 21° 56′, E. Long. 96°. (*j*)

CHAIN. See SURVEYING.

CHAINWORK.

UNDER this head may very properly be ranged some of the most extensive and useful manufactures of this country. The term *Chainwork* is used for those substances, whether lineal or superficial, in which any kind of cordage or thread is linked together in the form of a chain, for any purpose of useful or ornamental manufacture. The variety of these is considerable, and their utility renders all of the branches very extensive.

Of the lineal kind, the ornamental manufacture known by the name of Tambouring, and now very extensively practised in this part of Great Britain, is the principal.

Under the superficial, every class or branch of hosiery may be included, whether plain or ornamental; and all the varieties of the lace manufacture, as practised both upon the continent and in Great Britain. It also may be considered as including every species of network, whether of that flimsy and light kind, which is manufactured either in the weaving loom or stocking-frame; or the more substantial kinds, employed in the various fisheries, for lining the sides of ships of war, and many other purposes. These manufactures, being strictly little more than varieties of the same class, it is proposed, in the present article, to give some account of them, in the following order.

1*st*, Lineal chaining, or tambour work, as executed both by the hand and by the recently invented machinery.

2*d*, The various leading branches of the hosiery or stocking manufacture.

3*d*, Reticulation, or net-work of various kinds, especially that which, by promoting and extending the British fisheries, is of the most essential importance to every branch of the community.

It can hardly be expected, that, in a field so unboundedly extensive, every detail should be included; but if a general view of the whole, combined into one *focus*, can be effected, the object will be in a great degree attained. The first, then, to which attention is to be paid, is the principles and practice of tambour or chainwork on cloth.

CHAP. I.

Application of the principle of Chainwork to Tambouring, or the production of ornamental Flowers and Figures upon Cloth.

The close and compact form which the linking of any kind of thread or yarn, into the form of a chain, assumes when tacked upon the superficies of the lighter fabrics of cloth, has been very successfully and extensively applied to many species of ornamental manufactures of this description. Of the origin of these manufactures, if any record has at all been preserved, it has never reached the public view; and as it seems highly probable that most of them either originated, or were first noticed, in those recesses of monastic seclusion, to which it became the policy of the Roman Catholic priesthood, during the plenitude of the papal power, to devote even a very great proportion of the female population of Europe, it was hardly to be expected that arts, which were deemed at least childish and nugatory by the men, whose chief trade was war, and whose ambition and interest alike were gratified by the profession of arms, should form objects of curiosity or attention. The priesthood alone, unenured, and probably but little inclined to exercise in their own persons those military talents to which they were too often sufficiently anxious to prompt the laity, were almost the only depositories of every art, as well as every science; and their obvious policy dictated the concealment, more than the propagation, of every art and science, by the knowledge of which either celebrity or wealth might be attained. If this general principle be studied with candour and patience, we shall be at very little loss to account for the almost universal ignorance of what are termed the dark ages; and it is at least a matter of some curiosity to trace the same principle which directed the most powerful empires and monarchies, even so low as to regulate the casual employment of the meanest female. In the exercise of most of those manufactures which we have derived from our intercourse with our continental neighbours, we have, very naturally and very wisely, been at more pains to adapt them to suit our own purposes, than to conceal their origin; and the original names remaining generally serve us to trace their origin.

The original frame upon which cloth is stretched to undergo the operation of the hook, which forms the chainwork upon its surface, consists of two circular hoops; the outer ring being coated round with lists of cloth, or any other soft and compressible substance. The cloth being stretched over the inner ring, the outer is applied, and the friction of the two gives the whole means of tension. These frames, or hoops, in their most simple form, are merely held between the knee and the chin of the operator, while working. As this is a clumsy and inconvenient posture, the first improvement seems to have been confined to the addition of a pedestal, upon which the hoops might rest, and the female, who performed the work, might sit in a more easy posture while at her employment, or leave it with ease and security for the purpose of attending to any other domestic occupation.

Such has been, and probably still is, the state of this art upon the continent, excepting in Switzerland, where it has been long a source of marketable profit, rather than domestic ornament.

As an ornamental branch of what is termed *ladies' work*, it has been long known and practised in Britain; but its introduction, as an article of general manufacture, is much more recent than the first practice. The introduction of it into the western part of Scotland, where it is chiefly exercised, hardly exceeds the period of thirty years; and in the early instances, it was chiefly under the direction of foreigners. As the art, which is very simple in its principle, but requires a great degree of manual dexterity and practice, became more extensively used, means to obviate two inconveniences attending the *tambour*, or *drum tent*, were first employed.

It was found convenient, where a piece of cloth was broad, and a pattern close and tedious, to employ a number of hands upon the same piece, in order that it might be quickly finished and brought to market. Hence the invention of the common tambour frame, now universally used in those districts of Britain where the manufacture is practised, took its rise. This tent, or frame, is excessively simple, consisting merely of two parallel rollers placed horizontally in a wooden standard, and furnished with ratchet-wheels and catches, to preserve or augment, when necessary, the tension of the cloth. When the cloth is $\frac{6}{4}$ or 54 inches broad, six girls may be employed upon the same piece without impeding each other while at work, and by dividing the cloth, which is stretched between the rollers, at one time, either into equal portions, or according to the capability of the respective workers, it must be evident that a very powerful spirit of emulation will be excited, which will very far overbalance any disadvantage arising from delay, in any of them detaining the others while finishing her particular portion.

The operation consists in drawing the loop of a thread successively through the other loop, so long as the work is continued; and as all those loops would be undone in a moment, merely by pulling the end of the thread which has been used, it becomes necessary to make the end fast, either when a thread is exhausted, or a figure finished. The appearance of the chain will be found by inspecting Fig. 5, Plate CXXXVII.

To apply tambouring to ornamental purposes, the variegation of these chains is all that is necessary; but the judicious application of this to actual practice, is the great excellence of those who are esteemed most dextrous at their business. From this the whole art may evidently reduce itself to two heads, viz. chaining, and directing the chain. The first of these is that property which brings the art of tambouring within the general scope of this article. The second is that particular application of chaining, which fits it for the special purpose to which it is to be peculiarly applied. The *chaining* part of the operation is in every particular analogous to the principle of the stocking manufacture, excepting that we may fairly consider hosiery as a superficies, and tambouring as a succession of lines, drawn in such directions as to constitute a superficies of that form which we require, and that this latter superficies only partially covers another, which forms the plane upon which it is placed, for the purpose of ornament.

As an article of manufacture, considered as a source of national or individual wealth, the tambour manufacture may be regarded in three points of view.

1st, As it becomes a source of employment to the poor and laborious classes of the community, and how far either general or individual comfort may be promoted by the cultivation of the art; and, consequently, how far, in a moral point of view, it may have been either beneficial or injurious to society.

2dly, If considered merely as an article of innocent luxury, what proportion of the population of Britain may be fairly directed to it, without prejudice to the exercise of relative duties more important and indispensible?

It has been computed that the tambouring of muslins, when at its greatest extension, employed at least 20,000 females, either wholly or partially. Of these females, many lived in the vicinity of Glasgow, the chief seat of the manufacture, and others were scattered through almost every part of Scotland, and supplied with work and money by agents employed by those manufacturers, who found it their interest to embark extensively in the business. Whether the diversion of even the occasional industry of 20,000 females from all the common duties of life, for the purpose of ornamenting a few rags, which would hardly bear the alkaline deterioration produced by half a dozen of washings, was a proper direction of the energies of a country, may be very fairly questioned. Even in the most remote parts of Scotland, while the business was general, the effects were prejudicial both to the morals and the comforts of the people. In Glasgow, they were to the last degree deplorable; a tambourer of ordinary dexterity could, in general, earn five or six shillings a week, by constant application. By those vicissitudes of price which the almost constant fluctuations of the mercantile system produce, a great deal more could sometimes be obtained. To the labouring artizan, who could with difficulty procure the necessaries, and but seldom the comforts, of life, the possession of a few daughters became really a source of wealth; every thing therefore was, in most instances, sacrificed to the tambouring. At five years of age, when it was found that a child could handle a needle, and perhaps earn a shilling or two in a week, every idea of education was instantly abandoned. A female child was rendered incompetent to the performance of any one social duty, that she might bring a shilling or two more home upon Saturday. The children finding their pecuniary value, soon began to think that the application, as well as the earning, of money, came immediately within their *proper* cognizance. The consequence was natural; theft and prostitution followed so closely upon the heels of misdirected industry, that many never saw the age of 20 years! The picture could be much more highly coloured, but it would become nauseous and disgusting. The outline is faithfullly drawn from long observation, and could be confirmed by viewing the untimely graves of many thousands! Were the picture coloured, it would be unfit for human view!

It would be a ridiculous affectation of morality, which could hardly gain credit, to say, that these were the chief objects which directed the attention of the author of this article to the invention of the machinery, by which this direction, or mis-direction, of human labour might be at least in a great degree superseded. But although this might have, in some degree, resulted, or may still perhaps result, from the use of the machinery, if the demand for tambour work continues, the immediate stimulus, as in all commercial pursuits, was directed by personal interest. By restoring a number of efficient beings to the exercise of fair industry, in objects which promised to be of great benefit, both to themselves and to the public in general, he might indeed have done some good to society. The immediate use of the machine, it is his present object to describe, and this may perhaps prove more likely to attract the attention of his reader.

Patent Tambour Machine.

The first idea of this machine arose from a casual conversation with a gentleman, at that period extensively engaged in the muslin manufacture, and fond of mechanical pursuits. Some study convinced the inventor, that the construction of a machine, which, by bringing into action a great number of needles at the same time, would shorten the process by manual labour, and might be rendered actually efficient, was perfectly practicable. The diversification of pattern seemed to constitute the whole difficulty, and the application of Sir Isaac Newtown's principle, of two forces acting at right angles to each other, presented a facility of overcoming this obstacle, which encouraged him to proceed. To apply this principle in the various ways which might effect his purpose, did not occur for a long time afterwards, and his first idea was confined to the construction of a machine, which might be put in motion by a person who should exercise his discretion in shaping the pattern, whilst he should be enabled to perform all the other operations by the pressure of his feet. It seemed more easy to move the cloth than the needles, and for this reason the cloth frame was made to shift in both directions; at the same time he received a suggestion, that a perpendicular position might admit of many conveniences of which a horizontal one could not be made susceptible; and satisfied of the justice of the remark, he immediately adopted it. After some consideration, a machine was constructed under his direction, and afterwards a second, which he casually superintended, being at that time engaged in other pursuits. After two years, he formed a connection, by which his whole study and time were to be devoted to the completion and practical application of his invention. Six of the machines were set to work in this way, after which he was sent to London by the company, in order to procure the patent, and comply with that proviso common to all patents, which requires a specification of the invention to be enrolled in the Court of Chancery within thirty days of the sealing of the patent. At this period, the idea of rendering the machine automatic had barely presented itself to him, and consequently the last part of the specification which describes the possibility of applying mechanical power, is stated as merely prospective. Upon his return, he extended and applied this principle so long as the work was under his direction. The results of that experience, and what has since occurred to him, will be found in the description which follows.

In Plate CXXXVI. are represented four elevations of this machine, according to the latest improvements made upon it. Fig. 1. is a transverse elevation, viewed in front, or at that part where the person who has the care and superintendance of it is supposed to be placed. At AAA, are three upright posts, being exactly one half of what are used, those behind corresponding in every respect with those in front. At B is a horizontal cross-rail, of which one is before and two behind. The frame in which the cloth is stretched appears at C, the lower beam and under part being concealed by the beam D, but correspondent in every particular with the upper part, which is visible. At E is the middle frame, which in that work contained 54 needles, each being placed at the distance of one inch asunder, and designed to tambour a piece of muslin 6-4ths wide, one whole row being wrought at the same time. The cloth frame is suspended, so that it will move freely, and without the exertion of much power, either upwards or downwards; and with equal facility from right to left, and *vice versa.* To ensure this, the roller G is placed above; and in order that both sides of the cloth frame may rise and sink equally, cords are attached to each end, which, after passing a sufficient number of times round the roller G, descend upon the opposite side, where the weight of the frame is nearly, *but not quite*, counterpoised by the weights LL.

The tension of the cloth is preserved by ratchet-wheels and catches to either roller, precisely as in a common tambouring tent; and in order that it may be stretched *laterally* as well as *vertically*, at each side was a piece of iron filed with wire hooks, which took hold of the selvage of the cloth, and which operated exactly like those frames for drying cloth, used at bleachfields, and called by the name of stenters. In the double framing at the right hand, that part of the machinery which forms the pattern is contained, and this consists of four wheels fixed upon the same axis, which was a bar of iron one inch square. Of these wheels, three were 18 inches in diameter, and one 26 inches. The wheel nearest to the front of the machine is a ratchet, and merely regulates the motion of the others. It was customary to form two flowers by one revolution of the axis, because when the flowers were similar, every second row was reversed, and when dissimilar, every alternate row was of the same form. In the first case, the ratchet-wheel formed a flower by half a revolution; in the second, the number of teeth corresponded to the number of loops or stitches in the respective flowers. The next wheel in order communicated the horizontal motion to the frame in which the cloth was suspended; the third wheel gave the perpendicular motion; and the fourth, or 26 inch wheel, gave a rotatory motion to the needles upon their own axes. The second and third wheels, of course, were those immediately employed in the formation of patterns; and it may be proper in this place to give some account of the principle by which they were fitted for this purpose, as it is by far the most curious and least understood part of the whole machinery.

The principle upon which this motion is constructed, and which is susceptible of infinite variety, depends upon the two following corollaries to the third law of motion, as given in Sir Isaac Newton's *Principia*, and extracted from Mr Motte's translation, edition 1803, pages 15, 16.

" *Cor.* 1. A body by two forces conjoined will describe the diagonal of a parallelogram in the same time that it would describe the sides of these forces apart.

" *Cor.* 2. And hence is explained the composition of any one direct force out of any two oblique forces; and, on the contrary, the resolution of any one direct force into any two oblique forces; which composition and resolution are abundantly confirmed from mechanics."

Upon the application of this theorem, that profound and illustrious philosopher founded the first rational and satisfactory explanation of the causes of the elliptical orbits of the planets, and accounted for the causes by which the whole system of the universe is regulated; and the recent discoveries of La Place, and other eminent philosophers of the French school, are merely extensions of the same general law, involving the effects produced by the gravitation of the planets towards each other, as well as towards the sun. To apply this principle to the construction of the tambour machine, or any other requiring extensively varied motion, it was only necessary to produce two direct motions, which, as being the most simple and efficient mode of construction, were placed at right angles to each other, one being in a vertical, and the other in a horizontal direction; and as it is easier to communicate motion to one body than to many, it was found better that the motions which produced a relative change of position between the cloth and the needles, so as to regulate the successive points of perforation, should be given to the former rather than to the latter. In the first construction of the machine, the motion given to the cloth frame was effected by two screws, one placed vertically, and the other horizontally. As the machine in this state was wrought by the operator's hands and feet, and entirely under the guidance of his discretion, the screws were turned by his hands, by two small winches, so calculated, that when either winch was turned to the extent of a quarter or quadrant of one revolution, a shift of the cloth, equal to $\frac{1}{32}$d part of an inch, was produced. This was found a proper length when the motion was directly given by one screw, either vertically or horizontally. But when any intermediate angle was to be formed, it required that the shift should be less in both screws, as the oblique line produced by the combined action of both screws was always greater than either side apart, in the same ratio that the hypothenuse of a right angled triangle exceeds that of either of the sides. When the screws were judiciously turned, this operation succeeded very well; but as the ratio of the one to the other constantly varied, even the most careful operators, totally ignorant of the most simple elementary principles of trigonometry, were in constant danger of error; and when entrusted to women or boys, which considerations of economy rendered peculiarly desirable, it was found impossible to place much reliance upon the quality and regularity of the work. These reasons, therefore, induced the inventor seriously to endeavour to find some remedy, which, by fixing the motions of the machine under regular mechanical laws, should entirely remove both the blunders and inaccuracies of human agency, and this he was enabled to effect by removing the screws, and substituting the traverse wheels. When this point was gained, very little more was necessary to render the machine entirely automatic, and this was speedily effected.

In order to form a rule by which a pair of wheels may be formed, to produce a straight line at any angle of obliquity, nothing more was necessary than to construct a table of trigonometrical calculations from 1° to 89° inclusive, the measure of the hypothenuse being always the side given $=\frac{1}{32}$ of an inch; but to execute such minute measures with accuracy, it became necessary to invent a machine for the regulation of those divisions. In order to effect this, he availed himself partly of the principle of the common clock-makers' cutting engine, and partly of the best description which he could find of Mr Ramsden's celebrated machine for dividing astronomical instruments. Combining these with such variations as suited his particular object, he contrived a cutting engine, by which he was enabled to cut with considerable precision and accuracy to divisions so minute as the 1200th part of an inch, and this was found quite competent for every practical purpose.

When the cutting machine was completed, the given measure of $\frac{1}{32}$ was effected by turning a handle or winch 18 revolutions, consequently 18 became the constant measure of the hypothenuse; and from these the vertical shift was equal to the perpendicular of the triangle; the horizontal shift to the base; the angle of obliquity, contained between the base and hypothenuse, constituted the deviation from the horizontal line, and its complement the deviation from the perpendicular. If this table be geometrically examined, it will not be found absolutely correct; but taken as an approximation for a practical purpose, its greatest deviation will not exceed $\frac{1}{1000}$th part of an inch, which was deemed sufficiently near.

From this table a very correct practical rule was found for straight lines in every direction of obliquity, and the curved lines were constructed in a similar manner, by supposing every curve to be the arc of a circle of some specified dimension. That none of them could be geometrically circular, will be obvious from the simple consideration, that being a succession of loop or chainwork, the tendency of the thread or yarn was always in a direct straight line when stretched, and consequently all circular curves were treated as inscribed polygons, the number of whose sides was so great, and the measure of each so minute, as to render the deviation from an actual circle imperceptible to the eye.

The Polygonic Tables, a few of which are annexed as specimens, were then calculated, to show by inspection the angle which each would form with a horizontal straight line, and these were instantly found merely by referring to the tables. In order to apply these tables to the formation of any pattern required, the usual and perhaps the easiest way, was generally to draw the pattern upon a very enlarged scale. To calculate the number of loops required was the next object, and this in straight lines was easy from actual measurement, 32 loops being always allowed for an inch. The curves being always supposed to be arcs of some circle, were found by the common analogy which the circumference of a circle bears to the diameter, the medium proportion as 115 to 355 being generally used. Were more minute calculation necessary, elliptical, parabolic, and hyperbolic curves, might have been very minutely found; but it never appeared necessary in a business which only required a sufficient portion of accuracy to please the eye, to expend time upon such extreme nicety. These were the general rules observed in this business; and the Tables, with short explanations of each, will be found at the conclusion of the article.

The cloth frame being loosely suspended, and its motion regulated by the cylinder above, it was further suspended by the centre from one end of the lever H, the other end of which was connected by means of two stout iron wires, with a piece of iron furnished with a small friction wheel, and acting on the rim of the perpendicular traverse wheel directly under its centre. The tendency of the frame to descend, produced a gentle pressure of the friction-wheel against the rim of the traverse, and according to its shape the frame was either lowered or raised at every shift of the wheel.

The communication between the cloth frame and the horizontal traverse, was effected merely by a small connecting bar of iron between the edge of the cloth frame and the wheel, the rod being placed directly level with the centre of the wheel. The pressure against the wheel was very simply effected, merely by tying a piece of whip cord to the frame, and after passing it over a pulley, suspending a small weight to the other extremity of the cord. A screw was also attached to the breast-beam, by which the cloth frame could be raised at pleasure, to present fresh cloth, by shifting a notch in the suspensary rod C. Thus ten or twelve rows could be wrought without shifting the beams upon which the cloth was stretched. The general motion was communicated by a leather belt passing over the pulley at N, and the machine could be engaged or disengaged at pleasure, by means very similar to those used for other machinery. When a flower was finished, the ratchet-wheel moved a small lever, which instantly stopped the machine, in order to prevent accidents. There were three treddles below, moved by wipers upon the cross shaft, by which all the motions were given. The first, P 1, served to set forward the needle frame, so as to produce the perforation of the cloth by the needles; the second, P 2, set in motion that part of the machinery which supplied the needles with thread, and which is afterwards to be described; and the third, P 3, moved the ratchet-wheel one tooth between every perforation. These were the chief motions in front of the machine. Some idea of those behind may be formed by inspecting Fig. 2, which is a view taken directly behind the machine.

Of the parts here visible, those which can be seen in Fig. 1. are distinguished by the same letters. The remaining parts are as follow: At Q is a roller or cylinder of wood, which gives motion to the needle frame; it is operated upon by a chain or wire, communicating with the treddle, which produces the perforating motion, and returns by the gravitation of a weight suspended from a stud in the opposite side of the cylinder, as soon as the pressure is removed. At R appears that part of the machinery which, by the operation of the treddle P 2, gives the rotatory motion which supplies the needles with the yarn, and which will be better understood by referring to Fig. 2. in Plate CXXXVI. At T, Fig. 2, Plate CXXXVI. is a lever suspending a weight which elevates the ratchet R, as soon as the pressure of the wiper is removed from the treddle. At S is a guide by which the motion of the ratchet is regulated. At U is the weight which produces the returning motion of the needles to the front, after being supplied with the thread. At V, V are two studs driven or screwed into the roller Q, with joints, by which the connection is formed with the back part of the needle-carriage, to produce its reciprocating motion.

In Fig. 3. is a profile elevation of the left hand part of the machine, or that most remote from the traverse wheels, and contiguous to the part where the moving power is applied. In this figure the upper part of the cloth frame appears at C, with one of the ratchets for distending the cloth. The upper roller is at G, and the balance weights guided by the pulleys at C, appear at L. At O is the centre of the shaft which carries the wipers, and at Q the back roller, as in the preceding figures. At *a* is a piece of iron by which is suspended an iron bar, which opens and shuts the barbs or hooks of the needles. At *b* is a profile of the needle carriage. At E is the needle frame, the form of which is now more apparent. At *d* is a screw which serves as a stop for the carriage, and which may be tempered at pleasure.

In Fig. 4. the forms of the traverse wheels become more apparent; 1 being the ratchet, 2 the horizontal, 3 the perpendicular, and 4 the needle traverses. At 5 and 6 are the centre screws, in which the axis revolves.

In Fig. 5. Plate CXXXVI. is a horizontal section of the machine immediately above the needle-frame. In this figure, many parts, partially or wholly concealed in the former, may be seen in their proper forms. The letters of reference denoting the particular parts are preserved the same as in the former figures, and a short recapitulation, with such occasional remarks as may occur, will probably be sufficient for the purpose of further illustration. Let the frame work be supposed to be cut asunder immediately above the level of the needle frame, and the six posts which support and connect the frame-work, will be represented by the letter A, six times repeated. Of this frame-work, the larger department at the left hand contains the general part of the machinery, whilst the smaller part to the right is exclusively appropriated for that portion which is peculiarly constructed for the formation of the patterns. At C appears a horizontal section of the cloth-frame, the top rail and upper roller being cut away. Immediately below the upper roller is a cross bar placed with its edge towards the cloth, and another bar exactly similar is placed below. These serve to keep the superficies of the cloth always at an equal distance from the points of the needles; as the diameters of the rollers are constantly varying by the cloth being unwound from one and rolled upon the other. At E is the horizontal view of the needle-frame, consisting of two strong iron bars, placed parallel to each other, at the distance of about four inches, with their edges upwards. Of these, the bar nearest to the front of the machine is perforated with small round holes at equal distances, the centres of the whole being exactly in the same straight line. The front bar, or that nearest to the cloth, is cut into triangular notches, also at equal distances, and which serve for the second support of the needle-handle. The triangular form was found superior to any other, because the handle, always pressing by its own gravity towards the acute angle below, touched both sides, and consequently left no room for the handle to shake, which would soon have been the case, by mere friction, even in the most accurately fitted bow. Besides this, it afforded a great facility for changing any needle which might accidentally be injured, and substituting another with little delay or loss of time. The bar next to E, after being bored, had another thin bar of malleable iron screwed to it, through which a number of small holes were drilled, and tapped to receive small screws, the centre of each small hole corresponding, as nearly as possible, with that which received the extreme pivot of the needle handle. These screws, the heads of which appear nearest to E, were found of very great practical utility; for if any small variation took place in the length of a needle when placed in the handle, it could be instantly corrected by turning the screw behind, either backwards or forward, as the case required; and thus all the points of the needles were preserved in the same straight line, and at equal distances from the cloth, notwithstanding any trivial inaccuracy in the setting. Contiguous to the bar furthest from the cloth was a slip of brass cut into the form of a rack, and extending somewhat more than the whole length of the frame. It was hung to the bar so as to move freely from side to side, and by means of a small pinion of 16 leaves upon each handle, communicated a rotatory motion to the needles upon their own axes, either from right to left, or *vice versa.* The teeth being below, neither them nor the pinion can be seen in Fig. 5.; but the mode of operation is distinctly visible in Plate CXXXVII. Fig. 1. Behind the cloth frame, at a few inches distance, is a cross rail or beam of wood, which carries all that part of the machinery which was appropriated to the purpose of supplying the needles with the thread, or as it is used to be called by the work people, the *feeding* machinery. On the centre of this beam, at R, was a small frame of cast iron, in which was the wheel work necessary for the rotatory part of the motion. The other motion was a reciprocating one, alternately approaching to and receding from the cloth, which was effected by an apparatus below, part only of which is visible. The use of both motions was as follows:

1st, In order to throw a loop into the hook of the needle, it was necessary that the thread should pass round the stem of the needle, in the interval between the time when the perforation was completed, and that when the needle returned after receiving the loop. This was performed by a separate set of brass needles, similar to those used by weavers for the weaving of lappets, and which are described under the article Cloth *Manufacture.* The motion of all these needles being entirely the same, they were driven into a bar of hard wood, at distances equal to those of what were termed the *working needles*, in the needle frame, so that they might correspond with each other respectively. Consequently a single rotatory or circular motion communicated to this bar, gave a corresponding motion to every needle which it contained. By these means, after the perforation had taken place, the first motion was a circular one of the feeding needle round the working one, which lodged the loop upon the stem of the latter. But as it was necessary that the working needle should be shut by a slider, to prevent the barb from injuring the fabric of the cloth when returning, it was also necessary, that before this operation took place, the thread should not only be thrown round the stem, but drawn backwards into the hook. This second operation was effected by the additional apparatus below.

A third motion was also necessary to insure the certainty of the hook always catching the loop when drawn back; and as the working needle required a rotatory motion on its axis, it became necessary that a corresponding motion should be given to the feeding needle, so that one should be always as nearly as possible in the directly opposite part of the circle to the other. The means by which all these different motions were effected, will be best understood by describing the particular construction of the machinery behind; and this is more clearly represented in Plate CXXXVI. Fig. 6. than in any other part of the Plate. The frame which contains all this part of the machinery, is represented at the letters AB, and a small additional frame is placed behind at P, for a certain portion of the wheels. The whole of this frame is to be fixed firmly upon the centre of the cross-rail behind, and at right angles to the rail, so that the oblique point O may project towards the back part of the cloth, at a few inches distance. The oblique projecting part of the spindle, or axis at O, is designed to answer the purpose of any common revolving crank, by moving round a given point, and carrying with it the bar in which the feeding needles are driven; and this motion is very simply effected by the perpendicular rack D working into the wheel C, which is loose upon the axis. The rack D is fixed to an upright or vertical rod of polished iron, sliding freely in two guides fixed to the rail or beam which carries the whole apparatus. The lower part of this polished rod is worked by the middle treddle, so that when the treddle is forced down by the wiper, the rack descending gives *rather more* than a full revolution to the wheel C. Attached to this wheel is a circle of brass E, larger in diameter than the wheel C, and furnished with a spring catch G, which rests in the wheel F, which is a ratchet. This, when C is pulled down the spring G, acting upon the ratchet F, which is fast upon its axis, carries it round, and as the spring does not work in the contrary direction, the rack returns for the next stroke, without bringing back the spindle; which would undo what had been done. Thus the whole revolution of the spindle is uniformly one way without returning. This is all that is necessary for the rotatory motion.

That motion, by which the feeding needle is always placed in the opposite part of the circle to the working needle, is effected as follows, by the wheels in the small frame behind. On the extremity of the spindle is fixed the pinion I, which revolves along with it, giving motion to the wheel with which it is connected, and which is loose upon its axis. To this wheel is fixed the ratchet K, containing only two notches which bisect the wheel, one being at each extremity of its diameter. The spring catch I, pressing on the circumference of the wheel, catches each of these notches in succession; the effect of which will be immediately seen. The wheel L is fast upon the axis, and is wrought by the rack M, which is screwed to a cross bar deriving its motion from the largest traverse wheel. Upon the large spindle the pully at H carries a small band, passing two or three times round it, and from each end of which is suspended a weight. That represented at N, Plate CXXXVI. Fig. 6. is much heavier than the one suspended from the opposite side, as its intention is to pull in a direction contrary to that of the impelling power. This excess of weight must be sufficient to pull back the band by friction, after the pulley has been stopped by the spring-catch I laying hold of one of the notches in the ratchet K. The effect of this apparatus is as follows. When the main spindle O has performed a revolution, or somewhat more, by the descent of the rack D, any excess is instantly cured by the joint operation of the balance-weight N, and the friction of the rack D in reascending; and the position of the tooth in the ratchet K becomes the stop, by which the relative positions of the feeding and working needles are preserved. Merely for the sake of conveniency, the calculation between the front rack for the needles and the back rack for moving the regulator K, was taken as two to one. Both derive their motion from the inverted levers KK, (Fig. 1.); and hence the range of one will always be proportional to that of the other. When the inverted levers are shifted either way, the needles before, and the regulating ratchet behind, change positions by the same power, and at the same instant. The perpendicular rack gives always more than a full revolution to the feeding crank, but the excess is instantly corrected by the action of the counterpoise N, and thus the relative position of the two frames is uniformly and correctly preserved. When the motion of shift is in the contrary direction, the spindle O is carried with the rest of the apparatus, to which the moving wheel C, being loose, presents no obstruction.

Of the operation of that part which produces the second, or reciprocating motion of the feeding-bar, the most correct idea will be formed by referring to Figures 3. and 4. In Fig. 3, a profile elevation of it is given, in which almost every part may be distinctly seen. Let A represent a cross section of the beam which carries the whole feeding apparatus. From this beam descends two projecting arms; one of which appears at B, and the other is in every respect similar. Their horizontal appearance appears behind R, in Fig. 4. Between these arms is a cross shaft, placed so as to vibrate freely in the centres; and at each end the perpendicular arms are joined by the cross shaft, the arms being fast upon the shaft. From the middle of the shaft, the lever E projects at right angles to the arms, and at the extremity is fixed a weight, in order to give it a tendency to descend; by which descent the perpendicular arms are impelled forward towards the cloth. From the upper part of the perpendicular arms, a connection is formed with the back part of the feeding bar, by means of two wires, with a hook or eye-joint at each end, to prevent them from impeding the circular motion of the bar. When the lever E is at liberty, the weight descends, and the feeders spring forward close to the cloth. When the perpendicular shaft which carries the rack of the feeding machinery (D, Plate CXXXVI. Fig. 6.) reascends, a jointed catch, represented at F, catches the projecting arm E, lifts it up, and produces the retrograde motion of the feeding needles, in order to pull the threads close into the barbs of the working needles. When the working needles are shut, and leaving the cloth, a small hammer, fixed to the back wooden roller, by striking a crank, forces back the catch; and the projecting arm E descending, brings the feeding needles again close to the cloth. Thus the reciprocating motion is communicated to the feeding bar. The form of the crank at O is useful for this motion, because it tends, when the bar recedes, to bring back the threads much more fully into the barbs of the working needles, than a rectangular crank, where much of the obliquity would still be preserved, could effect. In the first experiments, cranks of the common kind, and similar in appearance to what is represented by the lower dotted lines, were employed, and afterwards abandoned for this special reason, and after their inefficiency had become apparent from actual experience.

The chief parts of this complicated machine being now described, at a length as great as the limits of our work can admit, and perhaps tiresome to some readers, the mechanical description shall be concluded with some remarks upon that part of the machine, which is, of all others, that which requires the greatest portion of attention, and upon the accuracy of which the chief, if not the only difficulty, in actual practice was found. This lies in the construction of the needle, and apparatus belonging to it; and what illustration can be given by representation, without a great multiplication of figures, will be found in Figure 2. Plate CXXXVII.

The tambouring bears so strong an analogy to the stocking manufacture in the chaining, that at first the experiments were made with needles in every respect similar to those of the stocking frame, that is to say, with bent pieces of iron-wire, shut by the pressure of an iron bar, and re-opened by their own spring or elasticity. A very few trials proved this to be inapplicable to tambouring, for three reasons: The first of these was, that, by bending the wire, the flexure, which really formed the point of the needle, was too blunt to perforate the cloth, without risk of injury to the fabric; and the metal was too weak to bear sharpening after the flexure was made. The second was, that the pressure of the bar which shut the barbs, also made the stems yield very considerably, and this was apt to injure the cloth. The third reason was, that, in order to present the barbs to the action of the pressing bar, the needles required constantly to be brought back from the position necessary for the pattern, to one where the barbs would be vertically over the stems. In order to remove all these objections, a principle was adopted, by which all those objections were removed. The hook, or needle, was manufactured from solid wire. The barb was made very short, like that represented in the figure. The closing of the barb was effected by a small slider belonging to each needle, and the pressing bar entirely removed. The barb of the needle was cut like those of common fishing hooks; and, like them, the needles were made from *steel* wire, so as to be susceptible of tempering. This afforded a facility of sharpening the points, as much as those of sewing needles, and removed the other objections, as they could now be opened and shut in any position. In this improved state, their appearance will be found very much such as in Figure 2. This figure represents a section of the needle frame, the rack by which the handles are made to revolve, and all the apparatus for opening and shutting the needles. The point and barb of the needle appear at *a*; and the slider, which is partially sunk in a groove, sunk longitudinally in the stem of the needle, is at *b*. The slider is merely a piece of pointed wire, which has also a longitudinal groove, and is pointed pretty sharp. The slider was at first fixed to a piece of flat brass, with waxed silk, as fishing hooks are tied; but the silk being often cut, by friction and other causes, it was found better to cast a socket of tin round them, of the shape which the figure represents in profile. At *c* is a socket of brass, bored so as to fit the handle exactly, and slide freely upon it. The upper part of this socket being flattened, to receive the tin into which the slider is cast, they were screwed together; a slot being cast in the tin to allow it to slide a little backward or forward, for the purpose of fitting the tin, so that the points of the slider and needle might correspond when shut. At *f* is a section of a cast-iron bar extending across the machine, being the same as is represented in Fig. 1. Plate CXXXVI. at E. By the oscillatory movement of this bar, the sockets slide backward and forward on the handles, to open and shut the needles, each socket being grooved to admit a notch of the bar. The handle is at *g*, the pinion at *h*, and a profile of the rack at *i*.

These are the principal mechanical parts of the machine, which has been found to answer very well, and is still in use. Its chief defect is its complexity, and the fanciful nature of the work for which it is employed. For this reason, the reader will perhaps pardon the lengthening of the article a little, for the purpose of considering its practical economy, in point of expence, produce, and return, especially as those remarks are accompanied by a description of another machine, since invented, by the writer of this article, the expence of which will not exceed one-tenth part of that of the present, and whose product must be vastly greater. It is also so different in its principle, as to invade no one particular upon which the former patent rests for its validity. Mechanical descriptions, in general, also so very seldom embrace considerations of economy, or mercantile calculation of any kind, as often to be dangerous, instead of proving really useful.

Economy of this Invention.

It has been very generally and very justly remarked, that of the numerous speculators and projectors in mechanical inventions, very few, if almost any, derive benefit or emolument either from their genius or their labour; but that those who succeed them very frequently do. The causes of this phenomenon are of the first importance, to both the man of science, who devotes his time, his labour, and generally the most valuable part of his life to pursuits of this kind, and also to the capitalist, who, allured by the prospect of exorbitant profit, after expending large sums in untried speculations, ninety-nine times in a hundred finds his golden dream suddenly interrupted, and heavy loss the consequence of embarking in the dark, with no other guides to direct his course but cupidity and credulity. The experience of this invention affords a very fair, and, if properly considered, a very salutary, lesson to both these descriptions of people; and the author of this article does not know how he can discharge a more important, or more useful duty, than to present to others the results of long and dearly purchased experience. In the expectations of profit to be derived from every new invention, it is necessary, in the first instance, to examine, with as much accuracy as the nature of the business will admit,

1*st*, What is likely to prove the reduction of labour, and, consequently, of expence attending the improvement, supposing it to be completely successful.

2*d*, Of what nature is the business, and what prospect does it present of employment, extension, and permanence.

3*d*, Under the peculiar circumstances of the case, what capital will it require, both to overcome the constant impediments attending new experiments; to manure the invention; and, finally, to establish the business upon such a scale of magnitude, as will ultimately remunerate the adventurers.

Respecting the first of these points, the prospects attending the completion of this discovery were sufficiently alluring. The tambouring business had been established in Scotland for upwards of twenty years, and it might have been very safely assumed, that from twenty to thirty thousand people were either constantly or occasionally employed in it. During all this period, although, in common with every other branch of the muslin manufacture, it had undergone occasional vicissitudes, still, after every stagnation, it had constantly revived, and become equally or more flourishing than ever. Consequently, it seemed sufficiently rational to assume, that it had become a permanently established trade in the country; which, although subject to the vicissitudes common to all trades, and especially to those whose basis is rather founded on luxury than actual necessity, presented every prospect of holding a certain place in the general mass of manufactures at all times. It seemed further warrantable to conclude, that every improvement, which, by diminishing labour, must ultimately lower the price of the commodity produced, would contribute to its further extension, by bringing it within the reach of the most numerous class of the community, who were withheld, not by want of desire, but by want of wealth, from obtaining it. The monopoly attending the possession of the exclusive right of manufacture, also held out the most flattering temptation to the possessors, by affording a prospect of bringing the whole trade almost under their immediate controul. Such prospects might very naturally be supposed to operate powerfully, both upon the inventor, and those who embarked with him in the speculation; and, indeed, it would have required a more than ordinary share of moderation, not to have been sanguine in the anticipation of success.

Respecting the capital necessary, it was more difficult to form any precise or definite idea. Much must depend on the scale of magnitude upon which the business was to be conducted, and how soon its returns would be sufficient to furnish the means of its own extension, as far as prudence would warrant. When the business was begun, the first difficulty which presented itself, was the most proper means of providing the requisite machinery. At this time the patent had not been taken, and it became necessary, therefore, that a mechanical establishment should be provided, both in order to preserve the secret until legally secured, and to furnish the means of executing, with facility and dispatch, such improvements as must be constantly suggesting themselves in an infant undertaking.

The number of mechanics, and the tools and materials necessary for their work, required a very great expenditure before any return could be expected; and with the difficulties attendant on first experiments, it was upwards of twelve months before eight machines were completed. When the machines were set to work, almost the whole depended upon keeping the needles in a proper working state; and from the similarity of their construction, men bred to the stocking manufacture, were deemed the fittest for this purpose. But in order to induce these men to abandon the profession to which they had been bred, it was necessary, in the first instance, to hold out at least some stimulus of advantage; consequently the wages were high, generally about seventeen or eighteen shillings weekly. With the disadvantages of a new business, and the impossibility of at once paying wages proportional to the quantity of work, this large sum in a great measure counteracted the diminution of price produced by the quantity wrought by the machine, and the work was not very greatly cheaper than that done in the ordinary way. In order to get rid of this, which in a great degree counteracted the saving, it was proposed to employ boys, who might be procured for five or six shillings a week, and merely keep one or two men as superintendants. The reduction of price now became much greater, and the business afforded a much fairer prospect of success; but as the formation of the pattern was still entirely at the discretion of the worker, it was found almost impracticable to get giddy children to pay proper attention to the quality of the work. Conscious that if these defects were not remedied, the improvement must be still inefficient, the inventor set himself to contrive some means by which the pattern might be subjected to regular mechanical laws, instead of discretionary operations, upon the accuracy of which certain reliance could not be placed, and had proceeded to a certain extent with his improvements, when he was dispatched to London to procure the patent, and execute the specification. Upon his return, the improvements were completed, and he now indulged the flattering hope that he had at length matured his invention. The other partners, entering into his views, purchased the lease of a large house, with a steam engine, and removed the work to the new situation. Two machines were immediately set to work, and, besides great improvement in the work, the average quantity was more than tripled.

When these machines were set to work, boys were still employed to attend them; but this again produced an inconveniency of another kind:—their parents only kept them employed whilst it suited their own conveniency; and whenever it appeared adviseable to place them as apprentices to any regular business, they were suddenly withdrawn, frequently without notice, and the machines left vacant, until a substitute could be found and instructed. These reasons suggested the idea that young women, not under sixteen years of age, might be more beneficially employed, as the wages might be safely paid fully as high as could be earned by any other employment, and at the same time so low as to yield a great profit upon their work. By these means, and some improvements on the machinery, the work was gradually brought to the state in which the inventor left it. At this period, the following statement, taken from an average of three months, will show its actual state.

The flowers upon the cloth, it has been already observed, were at an inch distance, and the rows placed in the bosom of each other, so as to form diamonds. When the diamonds were truly formed, there were 72 rows in the yard, and this was most commonly the case, although sometimes the rows were a little more sparse. Hence the number of flowers upon a yard in length were 3888, and in a piece of 10 yards 38,880. But as a small excess of measure is always allowed, in general, it might be assumed, that the flowers upon a yard were 4000, and upon a piece 40,000. The number of loops or stitches in a flower also varied according to the pattern, but the average might be fairly taken at 30 to each. According to the common rate of paying work of this kind by the common manual process, the price might have been pretty fairly estimated at two shillings and sixpence per yard, or twenty-five shillings per piece. These prices, indeed, are liable to almost constant fluctuation, according to the quantity in the market, and the demand for them. Sometimes three shillings, or even three shillings and six pence were given, at other times they might perhaps be obtained, for a short time, at two shillings, or two and three pence; but the price quoted may be considered as a low average for good work. When wrought by the machine, the price was fixed at nine pence per yard, but in order to stimulate the workers to every possible exertion, when the quantity exceeded 15 yards per week, one penny additional per yard was allowed as a premium, and when more than 18 yards were done, two pence per yard was allowed. The effects of this system soon became apparent. Ten yards per week were at first thought to be a great quantity, but in less than three months, the minimum (accidents excepted) was 14 yards, and the maximum 22 yards. The average of the whole might be taken at 15 yards, or 60,000 flowers per week. The lowest quantity, compared with very constant exertion in the common way, was in the ratio of about 16 to 1, and in ordinary cases nearly 24 to 1. Every machine therefore enabled one person to do the work of 24. It will appear from this, that the rate of wages had risen very high, and far above that of any other employment. But as this had in a very short time arisen from the great improvement of the business, and as the inventor considered the good faith of the company pledged at least for some time, he prevailed upon them to continue the prices without reduction, so long as he continued to manage the work, which was only a few months. What has been the rate either of work, quality, or wages, since that time, he cannot say, for from this period he seldom visited the work, and a few months afterwards, circumstances occurred which made him resolve to visit it no more. Since then he has never seen it. From these premises the following practical conclusion may perhaps be fairly drawn; that where a constant demand exists for a manufacture, a reduction of the price of labour of at least three fourths of the whole must be a certain source, either of emolument to the adventurers, or of saving to the consumers. If the demand be such, that the former sale prices can be altogether or nearly maintained, while the expense of manufacture is greatly reduced, the emolument must accrue to the speculators. But if from competition, either of the same or similar manufactures, the sale prices are greatly reduced, the speculator may barely receive a competent profit, or may sustain an absolute loss, whilst the consumers derive the whole benefit of the discovery, by a corresponding reduction of price. A third and middle case probably comes nearer to the actual state of this and many other inventions, than either of the preceding. Taken in one point of view, an immense saving may be apparent; whilst, on the other hand, the manufacture may be so involved in contingent expences, and may require so great an extension of capital, as entirely to consume its profits, and leave an ultimate loss. In this case, an establishment was set on foot to occupy 60 of these machines, but only 12 were set to work. The rent, the millwork, and the engine, were all upon the full scale, while the productive part of the machinery was limited to one-fifth part. Against this, however, it is at least matter of serious reflection to consider, how far it might have been prudent to embark a sum sufficient to employ the whole establishment in the manufacture of a mere article of fancy, subject to every vicissitude of caprice and fashion. Upon the whole, it seems plain, that the business was either carried by much too far, or not far enough. The expence was incurred, a large capital sunk, and both fortitude and exertion were necessary to requite what had been risked. A sudden stop of every necessary effort at the most critical moment was certain ruin, and that was the policy unfortunately followed.

Upon the whole, experience has very clearly evinced, that large sums cannot be prudently expended upon machinery calculated for articles of mere fashion, and that the exercise of mechanical genius will always be better directed to provide for the actual wants and conveniences, than to gratify the whims and caprices of mankind. In a refined state of society, ornamental arts must always exist; but the establishments for producing these ought ever to be calculated to meet those frequent stagnations of demand, to which they are peculiarly exposed. The power required to drive this machine being very small, and even that capable of great reduction, by judicious alteration, an expensive establishment of millwork, moved by power, is not by any means inherently necessary for the business. The regularity of motion, produced by machinery, is indeed desirable; but the attendant expence is more than equivalent to any advantage gained by its use. It is desirable that one simple rotatory motion should direct the whole, but this might be easily given by the attendant's hand, in a way entirely similar to what is practised in the incle loom. The needle frame is a very expensive part of the apparatus, and this, as well as the whole concomitant machinery, may be easily dispensed with. The pattern wheels, instead of being 18 inches in diameter, might be reduced to six inches, with equal efficiency; and a pattern might be carried to any extent by constructing them as spirals. It is also very practicable to make common sewing needles answer the purpose of the perforators, and those may be purchased for 3d. per hundred, whereas the former, with the sliders, &c. cost upwards of 10 shillings. The quantity of work, upon a plan of this kind, might even be greatly increased, by working two, four, or six rows at once; and, at the same time, a machine might be constructed, by simplifying all its parts, certainly for not more than 8*l*. or 10*l*. and probably for much less. In such a state as this, the trade might easily revert to its natural and legitimate channel; for the expence being but small, the machines would soon become the property of those who wrought with them. They might be made to occupy so little room, as to be placed easily in an ordinary sized dwelling-house, and the connection between the employers and the employed might be rendered exactly similar to that which at present subsists in the weaving, stocking-weaving, and other branches of manufacture. The pattern wheels alone ought to be the manufacturer's property, and these might be delivered with the goods, and returned when they were finished, like the wheels used in lappet weaving. A sketch of the general principles of a machine of this kind, which embraces no one part of the patent granted for the former, will be found in Plate CXXXVII.

In this Plate, Fig. 6. represents a profile elevation of the machine, in every part of which the most rigid attention has been paid to simplicity and cheapness of construction. The frame work, which extends from the floor to the ceiling, consists merely of two upright posts of flat plank, represented at A, the dimensions of which may be four inches by one. These posts, one of which only is visible, being firmly secured at top and bottom, a single cross rail will be sufficient to connect them, and may be of dimensions similar to the posts, and placed upon edge. In Fig. 6. it is not visible, but appears distinctly at N, in Fig. 7. The top of the posts may be bolted to a cross piece of wood at B, nailed to the joists above. The cloth frame of this machine appears at HH, and from the curvature of its shape, the sides may be very conveniently made of cast iron, and the cross connections of well-seasoned wood. Of these cross connections, the two of principal importance are the triangular pieces at KK; for the top rail at H is merely used for the two suspensary cords, and if these were attached to the sides, both it and the bottom rail might probably be omitted, without any practical inconveniency. At I, I, are the two rollers for stretching the cloth, which may be made like those of any common tambour frame. In this machine the perforators are placed behind the cloth, upon the frame D. They may be made like common sewing needles, excepting that the eye being in the point, that end ought to be sharpened in finishing them, instead of being blunted to resist the thimble, as in the ordinary way. The other end may be filed into a triangular shape, like a glover's needle, and is to be fixed in a socket of tin like a stocking frame needle. This is effected by placing the needle in a mould, and pouring in the tin while in a state of fusion. The shape, both of the needle and the socket, may be accurately seen in Fig. 8, together with a section of the bar upon which it is placed, and the means of securing it by a bolt and nut, so that any needle, if broken, injured, or worn out, may be changed at pleasure. The whip, or yarn, is placed upon a hollow tin cylinder, as in the former machine, and every thread passes through the eye of the corresponding perforator. The motion given to the perforators is exactly the converse of that in the former machine; for here the perforation is from behind, and the reciprocating motion may either be given by wipers, or by two small cranks upon the ends of the shaft G, which is turned by the operator's hand. The form of the shaft appears in Figure 9. In the front of the cloth is a cross rail, to which is attached a frame carrying a number of perpendicular needles, one being correspondent to each perforator. When the perforators are brought forward, these needles, by the rising of the frame, pass between the perforator and the thread, and thus form a loop, which remains until the perforators are withdrawn and return again, and so on. The proper regulation of this motion is the chief matter of nicety and difficulty in the machine. Copious remarks upon its nature, and the means of effecting it with accuracy, shall therefore be given in the proper place; as upon this rests the only difficulty of which this machine appears to be susceptible, and, at the same time, it is of such importance that this motion should be executed truly and steadily, that without that being accomplished all the rest would be nugatory and illusive. The pattern motion is, in this machine, to be given by two spiral worms, which may be six inches in diameter, or even less if desirable. These are represented in Figure 10, and some description of them may be necessary. They so far resemble in principle the transverse wheels of the former machine, that the figure of the pattern depends solely upon the form into which their rims are cut, and this depends upon the principles of calculation already described. Were a motion introduced to shift the contact of the frames at the end of each revolution, any number of wheels contiguous to each other, upon the same axis, would answer entirely the same purpose; but forming them as spirals will do equally well, and save some additional machinery. In order to avoid the errors to which the ratchet was sometimes liable, on account of the inertia, it is proposed to substitute in this machine an oblique wheel, with what is generally termed by mechanics a double threaded endless screw. This being turned half a revolution for every shift, the whole shifts will be made with a precision, which may in every instance be relied upon.

For the purpose of allowing the cutter to come fairly in contact with every part of the circumference of the spiral traverses; while the pattern is cutting, it will be proper to construct them in pieces equal to one revolution of the spiral, and these pieces may be removed while cutting, and when the cutting is finished, all may be placed on the axis, and secured by screws, or any other sufficient fixture. In order to allow the friction wheels, which are in contact with the rims of the spiral, to traverse freely along, some such contrivance as that represented in Figure 10, may be adopted. To the lower extremity of each lever may be fixed a small bow or brace of iron, at right angles to the lever, and secured by a screw at D. Two cross shafts, one immediately above the other, may be fitted to slide freely in the brace from side to side. To each of these a small friction wheel may be fitted, with a groove in the rim, to lay hold upon the circumference of each spiral. When the spirals revolve, the friction wheels, by the action of the hollow grooves, will be drawn laterally along them from F towards E; and when they have completed their course, they may be drawn back by a weight or spring, whenever the groove in the friction wheel is removed from the circumference of the spiral. The perpendicular motion of the cloth frame will be very apparent in the elevation, Fig. 2.; for the action of the spiral upon the lever L will produce it, by means of the cords OO, passing over the pullies in the cross rail N. If these cords are double, and joined in the middle by the slipknot used by weavers for the cordage of looms, the frame may be tempered to remove any inaccuracy arising from stretching, with great promptitude and facility. The horizontal motion may be given to the cloth frame by a direct connection with the other spiral, as in the former machine.

This will perhaps be the most simple and efficacious mode of giving the traverse motion, where a single row of perforators only is to be used; but as it may be desirable to increase the quantity of work by using different rows of perforators at the same time, and as no insurmountable objection presents itself against this amplification of principle, it may now be proper to extend our views to the means of augmenting the scope of the machine, premising that the ratio of increment can never be so well ascertained or productive of actual benefit, as by practical experience. If, in the first instance, we propose to double the number of our perforators, so as to work two rows of figures similar, but inverted, we may adopt the machinery represented in Figure 11, with rational hopes of complete success. But here it will be evident, that from the very nature of our object, we must abandon the plan of giving the lateral or horizontal shift to the cloth, and communicate it to the perforators, as they must now work in inverted directions. It will also be necessary that the vertical needles, which secure the loops in front, must move along with the perforators, and that this must be done with great accuracy. In this case, therefore, the vertical motion may still be given to the cloth, but the lateral one must be communicated to the perforators. In Fig. 11. if a motion is given to the frame AB, by the action of a spiral traverse upon the lever A, the frame CD will operate constantly in an inverted direction, by means of the pulley and band at G. The upper frame being acted upon by the traverse, is kept pressing upon it by the operation of the weight F, and the lower frame works in constant opposition to it by that of the minor weight E, which preserves the tension of the connecting band at G. If four frames be wanted, the plan in Fig. 12. will effect it The motion of the middle frames 2 and 3, is exactly as before, and the motion is continued to the upper and lower frames by the cross clasps at H and I. A profile of these clasps is given in the small Figure 13. In using an apparatus so extensive as this, it will be necessary to devise means, either by hinges or otherwise, for speedily removing and replacing the upper frames, so that all may be accessible for the purposes of repair or regulation, without loss of time.

It will now be proper to advert to the means of preserving the relative position of the vertical needles in front to the perforators, and for this reference may be made to Fig. 14. Let the cross rail in front of the cloth, which is to support the needles which retain the loops, be constructed with a groove nearest to the cloth, into which a small wedge may be driven for each needle, as represented at A. Let the needle be cast into a socket of tin, of the form represented at B, and a small weight be attached to the oblique tail at C. In the side of this needle let a groove be punched, like that of a common stocking needle. At B must also be a socket upon which the tin may vibrate freely from side to side, and the gravity of the oblique weight at C will give the point a constant tendency to incline towards the left hand. The point rising through a groove in the frame at O, its position may be regulated with the utmost precision, by tempering the wedge at A, and thus it will be made to fit the perforator with very great nicety. The rising of this needle between the perforator and thread, will thus seize every loop; and the next consideration is to open these loops, so that the perforator may pass fairly through them at next perforation, without danger of missing. This, it is presumed, may easily be effected with great safety, and little danger of error, by the following addition to the apparatus. Upon the same centre at B, let there be a second needle, shorter than the former, and also fitted with an oblique tail to incline its point towards the left. The point of this short needle D, resting in the groove of the longer needle O, both will rise as one point, and any slight motion to distend them after being raised, will open a loop through which the perforator may pass with the utmost security at the next perforation.

From this general description the ground work of a machine may be obtained, which, embracing all the advantages, and extending the operations of the tambouring machine, avoids its most material defects, complexity and expence. The outlines, rather than a full detail, are given, not from any motive of concealment, but of caution, to represent it merely as what it really is, viz. an untried invention. Wipers of the forms of Figs. 15, 16, and 17, will give all the remaining motions, if fixed on the revolving shaft driven by the operator's hand.

The following table is precisely similar to that employed in the tambour work, and will serve as a rule for cutting either wheels or spirals, so as to produce every angle of obliquity which can be required in any pattern, however comprehensive or varied.

Proportional Trigonometrical Table, shewing the Ratio which the Hypothenuse of any Right Angled Triangle bears to the Base and Perpendicular respectively, the Measure of the Hypothenuse being uniformly = 18.

Angle.	Base.	Perpendicular.	Angle	Base.	Perpendicular.
1°	18	0	24°	16.5	8
2	18	0	25	16.5	8
3	18	1	26	16	8
4	18	1	27	16	8
5	18	2	28	16	8.5
6	18	2	29	16	8.5
7	18	2	30	16	9
8	18	3	31	15.5	9
9	17.5	3	32	15	9.5
10	17.5	3	33	15	9.5
11	17.5	4	34	15	9.5
12	17.5	4	35	15.5	9.5
13	17.5	4	36	15.5	10
14	17.5	4.5	37	15.5	10
15	17.5	5	38	14.5	10.5
16	17.5	5	39	14.5	10.5
17	17	5	40	14	11
18	17	5.5	41	14	11
19	17	5.5	42	14	11.5
20	17	6	43	13.5	12
21	17	6.5	44	13.5	12.5
22	16.5	7			
23	16.5	8	45	13	13

CHAP. II.

Manufacture of Hosiery.

As the tambouring manufacture is produced by successions of lineal chaining in various directions, the more extensive and useful branch of hosiery or stockings, may be regarded merely as the extension of the same to the formation of superficies. In the working of plain hosiery, the loops of the chain are precisely the same as in the tambouring; and the most simple, although tedious, way of producing this, is by means of four small wires directed by the manual operations of women, or what is usually termed *knitting*. The great time employed in this operation, however, has brought it much into disuse, in all those districts where, from the extension of manufactures, female labour has become valuable and productive; and it is now rarely practised, excepting as the occasional employment of females, whose subsistence does not solely depend on their labour; and in the northern counties and isles of Scotland, where female labour, from the want of manufactures, is neither much in demand, nor high in price. The northern islands of Shetland and Orkney are indeed almost the only places where knitting is now practised to any extent; and the very low prices at which these stockings are sold, sufficiently prove, that very little indeed is charged for the labour of knitting them. The art of knitting by means of wires is so entirely of that kind which can only be acquired by repeated trials and patient application, that it would be a fruitless waste of time to endeavour to teach it by description. The great time necessary for knitting by wires seems early to have been felt, for the invention of the frame is attributed to a Mr Lee of Cambridge, so far back as the reign of Queen Elizabeth, and upwards of two hundred years ago, at a period when practical mechanics was neither generally understood, nor extensively practised in Britain. Mr Lee, indeed, it is said, found so very little encouragement, and so many obstacles to the introduction of this machine in his own country, that he emigrated to France, where he found that patronage which he had in vain solicited at home. Thus, whatever honour England may claim as having given birth to the inventor of this most important and useful engine, it is to France that mankind are indebted for its having ever been matured and rendered practically useful.

No description or representation of any of the various stocking-frames in use, is to be found in any mechanical work hitherto published, as far as the writer of this article has been able to learn; and what little is said of it in former Dictionaries of Arts and Sciences, is confined to the meagre and unsatisfactory notice that such an engine exists, without the most distant attempt to describe either the nature of its construction, or the principles of its operation. It has been customary to apologise for this omission, by representing the stocking frame as a machine immensely complicated in its parts, and very difficult both to represent and to comprehend. The stocking-frame unquestionably presents this aspect to a stranger upon a cursory inspection, especially to one who is not previously intimately acquainted with the theory of mechanics, and the practical application of the laws and principles of motion. Yet in reality many compound engines exist much more complicated in their operation, which have been the subjects of reiterated discussion and description. The reason of the apparent complexity of the stocking-frame is by no means to be ascribed either to the number or to the complexity of its motions, for these are neither numerous nor complicated; but to the great number of its parts, and to the necessity which exists of compressing these into a very small compass, in order to fit them for the operation required. The principle by which a single loop is formed embraces the whole; and it is not the difficulty of forming one, but the necessity of forming many at the same time, that creates the apparent complexity.

There are now a great variety of different frames in use for producing various ornamental kinds of hosiery, and it would vastly exceed all reasonable limits to enter into a detailed description of each. A few, therefore, of those which differ most materially from each other, have been selected as specimens; and for an illustration of these the reader is referred to Plate CXXXVIII. The first, which indeed forms the basis of the whole, is that used for weaving or knitting plain hosiery, and is the common stocking frame.

Common Stocking Frame.

Of this engine a profile elevation is given in Plate CXXXVIII. Fig. 1, the various parts of which are as follow. The framing is supported by four upright posts, generally of oak, ash, or other hard wood. Two of these posts appear at AA, and the connecting cross rails are at CC. At B is a small additional piece of framing, which supports the hosier's seat. The iron-work of the machine is bolted or screwed to the upper rails of the frame-work, and consists of two parts. The first rests upon a sole of polished iron, which appears at D, and to which a great part of the machinery is attached. The other part, which is generally called the carriage, runs upon the iron sole at D, and is supported by four small wheels, or *trucks*, as they are called by the workmen. At the upper part of the back standard of iron are joints, one of which appears at Q; and to these is fitted a frame, one side of which is seen extending to H. By means of these joints, the end at H may be depressed by the hosier's hands, and it returns, when relieved, by the operation of a strong spring of tempered steel, acting between a cross bar in the frame, and another below. The action of this spring is very apparent in Fig. 8. In the front of the frame, immediately opposite to where the hosier sits, are placed the needles which form the loops. These needles, or rather hooks, are more or less numerous, according to the coarseness or fineness of the stocking; and this, although unavoidable, proves a very considerable abatement of the value of a stocking frame. In almost every other machine, (for example those employed in spinning or weaving), it is easy to adapt any one either to work coarser or finer work, as it may be wanted. But in the manufacture of hosiery, a frame once finished, is limited for ever in its operation to the same quality of work, with this exception, that by changing the stuff, the work may be made a little more dense or flimsy, but no alteration in the size or quantity of loops can take place. Hence where the manufacture is extensively prosecuted, many frames may be thrown idle by every vicissitude of demand; and where a poor mechanic can purchase his own frame, he is for ever limited to the same kind of work. The gage, as it is called, of a stocking frame, is regulated by the number of loops contained in three inches of breadth, and varies very much, the coarsest frames in common use being about what are termed *Fourteens*, and the finest employed in great extent about *Forties*. The needles are of iron wire, the manufacture of which is very simple; but long practice in the art is found necessary before a needle-maker attains that dexterity which will enable him both to execute his work well, and in sufficient quantity, to render his labour productive. The process of making the needles is as follows. Good sound iron wire, of a proper fineness, is to be selected; that which is liable to split or splinter, either in filing, punching, or bending, being totally unfit for the purpose. The wire is first to be cut into proper lengths, according to the fineness of the frame for which the needles are designed, coarse needles being considerably longer than fine ones. When a sufficient number (generally some thousands) have been cut, the wire must be softened as much as possible. This is done by laying them in rows in a flat iron box about an inch deep, with a close cover; the box being filled with charcoal between the *strata* of wires. This box being placed upon a moderate fire, is gradually heated until both the wires and charcoal have received a moderate red heat, for were the heat increased to what smiths term the white heat, the wire would be rendered totally unfit for the subsequent processes which it has to undergo, both in finishing and working. When the box has been sufficiently heated, it may be taken from the fire, and placed among hot ashes, until both ashes and box have gradually cooled; for the slower the wires cool the softer and easier wrought they will be. When perfectly cool, the next process is to punch a longitudinal groove in the stem of every needle, which receives the point or barb when depressed. This is done by means of a small engine worked by the power of a screw and lever. The construction of these engines is various; but a profile elevation of one of the most simple and commonly used will be found in Fig. 11. It consists of two very strong pieces of malleable iron, represented at A and C, and these two pieces are connected by a strong well-fitted joint at B. The lower piece, or sole of the engine at C, is screwed down by bolts to a strong board or table, and the upper piece A will then rise or sink at pleasure upon the joint B. In order that A may be very steady in rising and sinking, which is indispensible to its correct operation, a strong bridle of iron, which is shewn in section at E, is added, to confine it, and direct its motion. In the upper part of this bridle is a female screw, through which the forcing screw passes, which is turned by the handle or lever D. To the sole of the engine C is fixed a bolster of tempered steel, with a small groove to receive the wire which is to be punched; and in the upper or moving part A, is a sharp chisel, which descends exactly into the groove, when A is depressed by the screw. These are represented at F and H. At G is a strong spring, which forces up the chisel when the pressure of the screw is removed. The appearance of the groove, when the punching is finished, will be rendered familiar by inspecting Fig. 13. When the punching is finished, the wires are to be brought to a fine smooth point by filing and burnishing, the latter of which should be very completely done, as, besides polishing the wire, it tends greatly to restore that spring and elasticity which has been removed by the previous operation of softening. The wire is next to be bent, in order to form the hook or barb; and this is done with a small piece of tin plate bent double, which receives the point of the wire, and by its breadth regulates the length of the barb. The stem of the needle is now flattened with a small hammer, to prevent it from turning in the tin socket in which it is afterwards to be cast; and the point of the barb being a little curved by a pair of small plyers, the needle is completed.

In order to fit the needles for the frame, they are now cast into the tin sockets, or *leads*, as they are called by the workmen; and this is done by placing the needles in an iron mould, which opens and shuts by means of a joint, and pouring in the tin while in a state of fusion. In common operations, two needles are cast into the same socket. The form of the needle, when complete and fitted to its place in the frame, will be seen in Fig. 7, which is a profile section of the needle-bar exhibiting one needle. In this Figure, a section of the presser is represented at F; the needle appears at G, and the socket or level at K. At H is a section of the needle-bar, on the fore part of which is a small plate of iron, called a *verge*, to regulate the position of the needles. When placed upon the bar resting against the verge, another plate of iron, generally lined with soft leather, is screwed down upon the sockets or leads, in order to keep them all fast. This plate and the screw appear at I. When the presser at F is forced down upon the barb, it sinks into the groove of the stem, and the needle is shut; when the presser rises, the barb opens again by its own elasticity.

The needles or hooks being all properly fitted, the next part of the stocking frame to which attention ought to be paid, is the machinery for forming the loops; and this consists of two parts. The first of these, which sinks between every second or alternate needle, is represented at O, and is one of the most important parts of the whole machine. It consists of two moving parts; the first being a succession of horizontal levers, moving upon a common centre, and called *jacks*, a term applied to vibrating levers in various kinds of machinery as well as the stocking frame. One only of these jacks can be represented in the profile, Fig. 1; but the whole are distinctly shewn in a horizontal position, in Fig. 2; and a profile upon a very enlarged scale is given in Fig. 3. The jack shown in Fig. 1, extends horizontally from O to I, and the centre of motion is at R. On the front, or right hand part of the jack at O, is a joint suspending a very thin plate of polished iron, which is termed a sinker. One of these jacks and sinkers is allotted for every second or alternate needle. The form of the sinker will appear at S, Fig. 3; and in order that all may be exactly uniform in shape, they are cut out and finished between two stout pieces of iron, which serve as moulds or guages to direct the frame-smith. The other end of the jack at I is tapered to a point; and when the jacks are in their horizontal position, they are secured by small iron springs, one of which is represented at I, each spring having a small obtuse angled notch to receive the point of the jack, against which it presses by its own elasticity. In Fig. 3. the centre is at R; the pointed tail is omitted for want of room, the joint is at O, and the throat of the sinker, which forms the loop, is at S. The standards at R, upon which the jack moves, are called *combs*, and consist of pieces of flat smooth brass, parallel to and equidistant from each other. The cross bar RR, which contains the whole, is of iron, with a perpendicular edge or rim on each side, leaving a vacancy between them, a space to receive the bottom part or tails of the combs. The combs are then placed in the bar, with a flat piece of brass, called a countercomb, between each, to ascertain and preserve their distances from each other. These countercombs are exactly of the same shape as the combs, but have no tails. When both combs and countercombs are placed in the bar, it is luted with clay so as to form a mould, into which is poured a sufficient quantity of melted tin. When the tin has had time to cool, the countercombs having no tails, are easily taken out, and the combs remain well fastened and secured by the tin, which has been fused entirely round them. Thus they form a succession of standards for the jacks; and a hole being drilled through each jack and each comb, one polished wire put through, serves as a common centre for the whole.

The jack sinkers being only used for every alternate or second needle, in order to complete this part of the apparatus, a second set of sinkers is employed. These are, in form and shape, every way the same as the jack sinkers, but they are jointed at the top into pieces of tin, all of which are screwed to the sinker bar H, (Fig. 1.); and thus a sinker of each kind descends between the needles alternately. By these sinkers, the loops are formed upon all the needles, and the reason of two sets different in operation being employed, shall be assigned in describing the mode of working the frame. The presser of the operation, of which something has already been said, appears at F; and of the two arms which support and give motion to it, one appears very plainly at E, its centre of motion being at C. The circular bend given to these arms, besides having an ornamental effect, is very useful, in order to prevent any part from interfering with the other parts which are behind, by elevating them entirely above them. The extremity of these arms at the termination of the bends behind, are connected by a cross bar, which has also a circular bend in the middle, projecting downwards, for a reason similar to that already assigned. This bend is concealed in Fig. 1, but visible in the front elevation, Fig. 5. From the middle of the bend, the presser is connected with the middle treddle by a depending wire appearing at M, and thus, by the pressure of that treddle, the presser is forced down to close the barbs of the needle. The re-ascent of the pressore is sometimes effected by means of a counterpoising weight passing over a pulley behind, and sometimes by the reaction of a wooden spring, formed of a strong hoop, like that represented at K. The latter of these is preferred, especially by the Nottingham hosiers, because, as they assert, it makes the presser spring up with greater rapidity, and consequently saves time in working. How far this may be practically the case, it would be superfluous here to investigate; but it is obvious, that the wooden spring, if very stiff, must add much to the hosier's exertion of his foot, already exerted against the united spring of all his barbs; and this inconvenience is much complained of by those who have been accustomed to work with the counterpoise.

At L are two pullies or wheels, of different diameters, moving upon a common centre, by which the jack sinkers are relieved from the back springs, and thrown downwards to form the loops upon the needles. About the larger wheel is a band of whip cord passing twice round, the extremities of which are attached to what is called the slur, which disengages the jacks from the back springs. The smaller pulley, by another band, communicates with the right and left treddle; so that these treddles, when pressed alternately, turn the pullies about in an inverted order. The directions of these bands also appear more plainly in the front elevation, Fig. 5. The construction of the *slur*, and its effect upon the jacks, will also be rendered apparent by Fig. 4. In this Figure eight jacks are represented in section, the tail part of three of which, 1, 2, 3, are thrown up by the *slur* in its progress from left to right; the fourth is in the act of rising, and the remaining four, 5, 6, 7, and 8, are still unacted upon, the *slur* not yet having reached them. As the slur acts in the direction of the dotted line XX, (Fig. 2.) behind the centres of the jacks, it is hardly necessary to remark, that thus forcing up the tails must of course depress the joints by which the sinkers in front are suspended. The jack sinkers falling successively from loops on every alternate needle, in the way represented in Fig. 6. where both kinds of sinkers appear in section, the light part expressing what is above the point at which the throat of the sinker operates upon the thread, and the dark part what is below. The second set, or as they are called the *lead* sinkers, from the manner of jointing them, and suspending them from the bar above, appear still elevated; the position of the bar being represented by the line AB. But when these are pulled down to the level of the former by the operator's hands, the whole looping will be completed, and the thread CD, which is still slack, will be brought to its full and proper degree of tension, which is regulated by stop screws, so as to be tempered, or altered at pleasure. The sinking of this second set of sinkers, may be easily explained by Fig. 8. The direction of the sinkers is expressed by the line E; the bar from which they are suspended will be at A; the top frame is in the direction from A to B; the back standards at D, and the joint at B, is the centre of motion. If E is pulled perpendicularly downwards, the spring C will be contracted, and its upper extreme point G, will be brought nearer to its lower extreme point F, which is fixed. Again, when the force which has depressed E is removed, the spring C will revert to its former state, and the sinkers will rise. The raising of the jack sinkers and jacks takes place at the same time, by the hosier raising his hands; and for the cause of this we must revert to Fig. 2. The lead sinkers in rising, lay hold of notches which raise the extreme parts of the set of jacks ZZ, which are called half jacks. Between the extremities of these, at ZZ, is a cross bar, which, in descending, presses all the intermediate jacks behind the common centre, and restores them to their original posture, where they are secured by the back springs, until they are again relieved by the operation of the slur recrossing at the next course.

Working of the Frame.

In order to work a frame, the whole apparatus being previously put into complete order, the hosier places himself on the seat in front, and provides himself with a bobbin of yarn or stuff. This bobbin he places loosely on a vertical pin of wire, driven into one side of the frame contiguous to the needles, so that it may turn freely as the stuff is unwound from it. Taking the thread in his hand, he draws it loosely along the needles behind the barbs and under the throats of the sinkers. He then presses down one of the treddles to pass the slur along, and unlock the jacks from the back springs, that they may fall in succession. When this is done, the number of loops thus formed is doubled by bringing down the lead sinkers, and the new formed loops are lodged under the barbs of the needles by bringing forward the sinkers. The preceding course, and former fabric, being then again pushed back, the barbs are shut by depressing the mid treddle, and forcing down the presser upon the needles. The former work is now easily brought over the shut needles, after which, by raising the hands, both sets of sinkers are raised; the jacks are locked by the back springs, and the hosier goes on to another course.

From this, it will be apparent, that the remark made in the outset is well founded, that there are, in reality, no complicated or difficult movements in the stocking frame. Almost the whole are merely those of levers moving in their respective fulcra, excepting that of the carriage which gives the horizontal motion to the sinkers, and that is merely an alternate motion on four wheels. Yet the frame is a machine which requires considerable experience and care, both to work it to advantage and also to keep it in good order. This circumstance arises greatly from the small compass in which a number of moving parts must be included. Owing to this, the needles, unless cautiously and delicately handled, are easily bent or injured. The same circumstance applies with equal or greater force to the sinkers, which must be so very thin as to be easily injured. But as these must work freely, both in a perpendicular and horizontal direction between the needles, in a very confined and limited space, the slightest variation in either, from being truly and squarely placed, unavoidably injures the others. When a hosier, either ignorant of the mechanical laws of their relation to each other, or too impatient to wait for the assistance of another, attempts to rectify defects, he in most cases increases them tenfold, and renders the machine incapable of working at all, until repaired by some more experienced person. This circumstance has given rise to a set of men employed in this trade, and distinguished by the name of *upsetters*; and these people, besides setting new frames to work, have frequently more employment in repairing old ones injured by want of care or skill, than many country apothecaries, who live in healthy parishes, can find in curing the disorders of mankind.

It seems unnecessary to go further into detail respecting a machine so well known, and which requires practical attention, even more than most others. It may therefore be sufficient to describe shortly some of its varieties, the most simple and common of which is the rib stocking frame.

Rib Stocking Frame.

This frame, which, next to the common frame, is most extensively in use, is employed for working those striped or ribbed stockings, which are very common in all the different materials of which hosiery is formed. In principle it does not differ from the common frame, and not greatly in construction. The former general description will nearly apply to this machine with equal propriety as to the former: that part, however, by which the ribs or stripes are formed, is entirely an addition, and to the application of this additional machinery it may be proper to pay the chief attention, referring chiefly to Fig. 5, which is a front elevation.

This Figure has been already frequently referred to for the illustration of those parts of the machinery which are common to both, and those parts therefore require no recapitulation. The principle of weaving ribbed hosiery possesses considerable affinity to that which subsists in the weaving of that kind of cloth, which is distinguished by the name of tweeling, for the formation of stripes, with some variation, arising merely from the different nature of the fabric. In cloth weaving, two different kinds of yarn, intersecting each other at right angles, are employed; in hosiery only one is used. In the tweeling of cloth, striped as dimity, in the cotton or kerseymere, in the woollen manufacture, the stripes are produced by reversing these yarns. In hosiery, where only one kind of yarn is used, a similar effect is produced by reversing the loops. To effect this reversing of the loops, a second set of needles is placed upon a vertical frame, so that the bends of the hooks may be nearly under those of the common needles. These needles are cast into tin moulds, pretty similar to the former, but more oblique or bevelled towards the point, to prevent obstructions in working them. They are also screwed to a bar of iron, generally lighter than the other, and secured by means of plates: this bar is not fixed, but has a pivot in each end, by means of which the bar may have a kind of oscillatory motion on these pivots. Two frames of iron support this bar; that in which it oscillates being nearly vertical, but inclined a little towards the other needles. Fig. 9, which is a profile elevation, will serve to illustrate the relative position of each bar to the other. The lower, or horizontal frame, the ends only of which can be seen in Fig. 5, under *a a*, appears in profile in Fig. 9, where it is distinguished by *d*. The vertical frame at *a* is attached to this by two centre screws, which serve as joints for it to move in. On the top of this frame is the rib-needle bar at *f*, in Figs. 1 and 9, and one needle is represented in

Fig. 9, at *f*. At *g* is a small presser, to shut the barbs of the rib-needles, in the same manner as the large one does those of the frame. At *h* is one of the frame needles, to show the relative position of the one set to the other. The whole of the rib-bar is not filled with needles like the other; for here needles are only placed where ribs or stripes are to be formed, the intervals being filled up with blank leads, that is to say, with sockets of the same shape as the others, but without needles, being merely designed to fill the bar and preserve the intervals. Two small handles depend from the needle bar, by which the oscillatory motion upon the upper centres is given. The rising and sinking motion is communicated to this machine by chains, which are attached to iron sliders below, and which are wrought by the hosier's heel when necessary. The pressure takes place partly by the action of the small presser, and partly by the motion of the needles in descending. A small iron slider is placed behind the rib-needles, which rises as they descend, and serves to free the loops perfectly from each other.

In the weaving of ribbed hosiery, the plain and rib courses are wrought alternately. When the plain is finished, the rib-needles are raised between the others, but no additional stuff is supplied. The rib-needles intersecting the plain ones, merely lay hold of the last thread, and by again bringing it through that which was on the rib-needle before, give it an additional looping, which reverses the line of chaining, and raises the rib above the plain intervals, which have only received a single knitting.

Plated Stocking Frame.

The next description of stocking frame to which we would draw the attention of the reader, is that used for the manufacture of a cheap and showy description of stockings, whose fabric chiefly consists of cotton, but in which silk is so artfully intermixed as to give them an appearance when new, nearly, if not altogether, equal to those which are composed entirely of silk, although, after being exposed to repeated washings, this deception almost entirely disappears, from the swelling of the cotton, which forms the chief part of the fabric. The chief points of difference in this frame consists in the way of shutting or rather covering the barbs of the needles, in order to form the chaining. Of this variety some idea may be formed, by referring to Fig. 10. This Figure is a horizontal plan of the needles, and that part of the apparatus which supersedes the use of the presser, and in some respects fits the frame for purposes to which the presser is not well adapted. It has not been deemed necessary to represent any part of the machinery of this frame, excepting the needles, and a set of points corresponding with them, which supersedes the operation of a presser. The needles are cast into metal sockets like those of any other frame, and only differ from those commonly used in the length of the barb, which, in this frame, requires only to be of sufficient length to receive the loops, and guard against any danger of their slipping off after being so received. The sockets or leads appear between A and B, and are attached and secured to the needle bar much in the same way as in any other stocking frame. The points are at C, and the short barbs are represented by a black line drawn from each point. At E is another bar which slides freely backward and forward in two grooves of iron, one being at each side of the frame. This bar has also a circular motion on its ends or pivots, in so far as the points may be elevated or depressed at pleasure, as much as may be necessary. Both these motions are given by the hosier's hand, laying hold for that purpose of the handle at F. The operation of these is as follows: In the stem of the needle there is a groove, as in any other stocking-needle, and in each point there is also a groove. When cast into the socket, the needle is so placed that the groove may be above, as in the common way; but in the points the reverse takes place, the grooves being below. When it becomes necessary to shut the needles, the points being pushed forward over the needles, and a little depressed, the point sinks into the groove in the stem of the needle, and at the same time the groove in the stem of the point being below, receives the short barb of the needle, so that both are completely covered; and the loops may be transferred from the needles to the points, and returned at pleasure. The bar, also, upon which the points are fixed, being fitted so as to have a lateral shift, the loops which were upon one needle may be transferred to another, and returned at pleasure. The effect of the point when the needle is short, may be seen in Fig. 12, which exhibits a needle and point in this situation in profile elevation. The needle is at A, and the point at B. By these means, the texture, instead of being confined to a straight lineal direction, as in the rib frame, may be varied at pleasure; and where colours are used, a great variety of stripes, zig-zags, and other ornaments, may be introduced at pleasure. This operation is very analogous to that of weaving lappets by the common weaving loom, and also to what has been already described in the account of the tambouring machinery; all of them depending upon the resolution of two direct into one oblique motion, and the production of circular, elliptical, and other curves, by varying the ratio of inclination.

Fig. 14. exhibits a small hook, very much used by hosiers of every description, for picking up loops, which may be lost by the breaking of a needle; the depression of a barb, which has lost its elasticity; or any other accident which may occur. It is also used in constructing the breadth of the stocking at the ancle, forming the gushets, and all the minutiæ of shaping, which can only be acquired by practical experience, and of which, therefore, we have not attempted any description.

CHAP. III.

Principles and Construction of a newly invented Reticulator, or Machine for Weaving Fishing Nets.

A machine of this kind has long been wanted for the extension and improvement of the fisheries, in order to supersede the expence and inconvenience of procuring nets in sufficient quantity, and at low prices, which must ever be felt, whilst they are only to be obtained by the tedious mode of knotting them mesh by mesh. It may indeed be said, that the chief part of the labour devolves upon the fishermen and their families, who devote to this employment those seasons which are not employed in the actual prosecution of the fishery. However much this may be the case, it is sufficiently obvious, that in every part of the country many other useful and productive employments may be found, for those who can be spared from the net manufacture; whilst at the same time it must be of the utmost importance to establish a mean, by which nets may be cheaply and extensively supplied at all times, and at short notices. This would enable the fishers to derive every advantage from seasons of uncommon plenty, by increasing their stock of tackle whenever they found it beneficial, and would effectually guard them against those casualties and accidents which must often happen to nets immersed in the sea, and unavoidably exposed to all the dangers of high latitudes, foul bottoms, currents, and other contingencies. Two different scales of construction have occurred to the author of this article, each of which possesses some advantages, and is liable to some objections, which it may be proper to state previously to entering into detail.

The first of these plans has for its object the construction of nets upon a limited scale, so that the machine required for weaving them may be neither bulky nor expensive in the construction. Machines of this kind, it may be presumed, would in some respects be preferable to those of a more extensive kind, even although the saving of labour will not be in the same ratio. Most of the districts of Scotland contiguous to the stations where the herrings are found in the greatest abundance, are hitherto little engaged in other branches of manufacture, and consequently the relative prices both of provisions and labour are proportionally much lower than in the more populous seats of manufacture. It seems however rational to infer, that although this circumstance may be expected to furnish a plentiful supply of workers at low rates, the same assiduity, dexterity, and application, can hardly be expected, which will be found in places where habit has inured people to both the industry and regularity which conduce so much to the extension and prosperity of all manufactures. It seems also rational to conclude, that the introduction of any manufacture into places so situated, ought, in all cases, to be attempted upon a limited scale, and its subsequent extension proportioned to its success, and the dexterity acquired by practical application. In order as far as possible to adapt the projected machine to such a state of society as this, it ought to be constructed not only of limited dimensions, so as easily to find room in an ordinary cottage, but also with every possible attention to simplicity, so as neither to involve great expence in its original price, nor to be liable to frequent repairs, where it might be difficult, if not impracticable, to find proper mechanics. In order to effect a machine of this kind, it is proposed to limit the extent of net to be wrought to the measure of 36 inches in breadth, or one English yard. For a machine upon such a scale, a space not exceeding 5 feet square will be found amply sufficient, so that it may be accessible in every part; and this, it is presumed, might be spared even in a house of small dimensions, for an object of such material importance to all interested in the prosecution of any of the branches of the fishery, especially those which are carried on to the greatest extent, and which consequently require the most abundant supply of tackling. In order also to avoid all the expences attendant on the application of mechanical power, it would be proper that one person should be enabled, with facility and dispatch, to communicate to the machine all the motions of which it is susceptible, as in the common weaving loom, the stocking frame, and many other engines. Without actual experience, every calculation of quantity to be produced by any machine must ever be vague, and liable to great uncertainty and possible error, because neither the velocity at which the machine may be made advantageously to move, nor the dexterity of the operator, can be hypothetically calculated, without possessing more accurate data than can be safely assumed. A calculation upon assumed and specified data may however be made; and this, if moderately taken, may afford an approximation to the truth, and at the same time warrant a well-grounded hope, that when the machine has been brought to a proper state of accuracy in all its motions, and the operator has acquired a sufficient degree of practical dexterity, the actual result will rather exceed than fall short of the premised estimate. Upon this ground alone the following assumptions and calculations resulting from them are founded:

Let the breadth of net to be wrought at the same time be 36 inches, and the diagonal of every mesh from the opposite points of the diamond be 2 inches. Of course there will be 18 meshes wrought at the same time; and were it possible to work the machine at the same ratio of velocity with which a mesh may be formed by the common manual process, the ratio of increment of quantity, or diminution of labour, would be as 18 to 1. But as this is not to be expected, let us suppose that the machine, at a moderate velocity of action, would complete one row of 18 meshes even in the space of one minute, which is very slow indeed, and probably much underrated; the space of 36 minutes would then be required for every square yard of netting, and 12 working hours for each day's labour, the total result would be 18 yards *per diem*. Thus the labour of three boys or girls would be sufficient, annually, to equip a vessel of 70 or 80 tons burthen with her whole supply of netting. How far any part of the data, upon which this calculation is founded, may prove practically erroneous, it is impossible in the present state of the invention to ascertain; but as a very low rate of velocity is assumed, it may perhaps not be overcharged, and the actual result may be ascertained at a trivial expence, by the construction of a single machine.

Of the second kind of machine to which an allusion has been made, a very brief notice only seems necessary at present. Were machines to be constructed to act by the impetus of mechanical power, a much larger scale would probably be found advantageous. This must involve the preliminary expence of a building adapted to the purpose, with a waterfall and wheel or steam engine for the moving power. The machinery we might then suppose sufficiently large to work at once 6 yards, or the whole depth of a net; and were this done at an equal velocity with what has been assumed, the quantity produced would be immense indeed. The original capital sunk would however necessarily be very large, and, divested of every other impediment, much of the profit would necessarily depend upon the economy of management, and internal regulation. As, besides this, many parts of the same general principles would be common to both machines, the latter seems more legitimately calculated to be brought into efficiency, as an extension and improvement of the former, founded upon practical experience and observation, than as the first effort of an infant and unascertained mechanical experiment.

When, according to the first plan, a sufficient quantity of webs of netting, of the breadth of 36, 54, or 72 inches had been formed, they might easily be joined, by intercalary meshes formed in the common way, into nets of any requisite dimension; and if a supply of netting in webs, rolled up in a convenient form, were kept in the holds of fishing vessels, or in stores contiguous to the fishing stations, all accidents might be instantly repaired, all deficiencies supplied, and the stock of nets speedily increased, according to the exigencies which might occur.

Respecting the economy, or eventual reduction of expence, in the fitting out of vessels for the fishery, it is also impossible to enter into any estimate with precision. From what has been said above, if three boys or girls could, by one twelvemonth's labour, supply 20,000 square yards of netting, being what is represented as the quantity proper for a vessel of 80 tons, and if we suppose the labour of each of these to be estimated at four shillings per week, which in these districts is probably high, we have the whole quantity woven for 39*l.*, or at the rate of little more than one half-penny per square yard. On the advantages resulting from the creation of such a source of emolument, in districts where labour is scarce, and habits of industry at an early age peculiarly desirable, with the correspondent increase of the necessaries of life, upon which it is fair to calculate, it will not be necessary to enlarge. If a quantity of nets can also be at all times procured at so low a rate as here specified, adding a fair profit to the intermediate dealers, it must also prove of the utmost consequence to those who embark capital in the prosecution of the fisheries. The benefit to the salmon, trout, and other inferior branches of the fishery, though less in national importance, are also objects of attention to those immediately interested.

How far the plan detailed in the subsequent part of this article may conduce, either wholly or partially, to promote this great object, must be left to the consideration of those particularly interested in the prosecution of the fisheries. The inventor has been formerly practically employed in superintending and constructing machinery, novel in its principle, and vastly more complicated in its various operations than what is here proposed, and has consequently the less difficulty in estimating both the attendant obstacles, and ultimate practicability of his plan, subject to those variations, adaptations, and improvements of the particular parts, which experience alone will point out in their practical effects, and perseverance only will remove.

Of the general principle by which labour is to be obviated, it may be proper to say something, previously to entering into the particular details of the various parts of the proposed machine, and a description of the explanatory drawings which conclude the article.

Many species of reticulation, besides that exclusively adapted to the manufacture of fishing nets, have been already effected by the agency of machinery. Of these, the lace and stocking manufacture are, perhaps, the most prominent and extensive. That species of ornamental work called tambouring, is also a branch of the same. For the construction of machinery adapted to this branch, the inventor of the present plan some years ago obtained his majesty's letters patent, and the business is still conducted by those with whom he was connected in the invention. These circumstances naturally led him to consider, with some attention, all these various branches of the art, the practical purposes for which they were intended, and the shades of difference which subsisted between them. This circumstance led to that train of reflection which has produced this invention. The great distinction between the manufacture of nets for the fisheries, and other branches of reticulation, it is apprehended, consists chiefly in the manner of *knotting;* but the great requisite in fishing nets, is the complete fastening of the knots which connect the meshes, so that no fish may be allowed to escape, whether enclosed by hauling, or seized by the gills, in attempting to force a passage through the intersections of a stationary net. In no other species of reticulation, hitherto attempted by the agency of machinery, has this particular ever been deemed of paramount importance; and, consequently, the inventors of all the others have been contented with adopting *slip* knots, or loops sufficiently adapted to the objects which they had in view, but by no means so for the fisheries. The mesh knot, used in weaving fishing nets by the common operation, might certainly be tried by machinery, but it is by no means well adapted for dispatch; and, were the machine to proceed by one mesh at a time, no benefit whatever could accrue from the invention. Presuming, therefore, that any other knot *which is not liable to slip*, might be substituted for the mesh knot, the inventor, in the first place, bent his attention to analyse the various kinds of fast knots in use, especially those preferred by mariners, which he conceived to be the best adapted to his purpose. Among these he selected what is called the *ring knot;* both because it is equally fast with the mesh knot, and is also better adapted to the weaving of nets by machinery, although by no means equally so, for working them by single meshes. The ring knot is called also the *fisher's knot*, and is that used for connecting lines of horse hair employed in angling. If, according to our former supposition, the webs from which nets are afterwards to be formed, consist of meshes, the diagonals of which are two inches each, and the whole breadth of each web is to be 36 inches, or one English yard, it follows, that 18 meshes will be contained in the breadth; and it was premised, that, assuming this for the scale of a first experiment, these 18 meshes are to be formed and knotted at one and the same time, by the operation of the machine. From the diagonal form in which the meshes succeed each other, that part which, for distinction's sake, may be called the mesh frame, may therefore consist of 18 compartments, one being allowed for each mesh, and these might be variously constructed. One mode, which seems sufficiently well adapted for the purpose, is represented by Figures 1 and 2, Plate CXXXIX. as it appears in an elevated state; and its horizontal appearance, viewed from above, is given in Figures 3 and 4 of the same Plate. Perhaps, however, these may be better understood after a cursory description of Fig. 5. which contains a horizontal plan of the principal parts of the machinery, and of Fig. 6. which contains an elevation of the front part. It may here be premised, that the twine, or cordage, previously to the commencement of the process of weaving, is to be wound upon a certain number of bobbins of a particular construction; and when the reticulation is completed, the finished net work is received upon a roller or beam, from which it may be cut in such lengths as are best adapted to the proposed dimensions of the intended nets, so as to avoid waste or remnants; at AA, Fig. 5. appear the two side rails which compose the upper part of the framing of the machine. At BB, is the receiving roller, or beam, upon which the net is to be received when finished; and at CC are two ratchet wheels to regulate its motion. At DD is the mesh frame for forming the knots; and at F and G are cross rails of wood, which serve to regulate the motions of the twine while forming the meshes. In Fig. 6. AA are two of the upright posts which support the framing, and of which there are four. BB is a cross horizontal rail of wood, which serves as a framing for the bushes in which the spindles or axes which support the mesh frames revolve. The particulars of the construction of the mesh frames, or moulds, will be the subject of future description. In this plan, nine of them appear between F and F, which is the number required for a net of 18 inches in breadth, the diagonal measure of each mesh being supposed two inches when equally distended both ways in the form of a diamond. At C is another cross rail, perpendicularly under that at B, which supports the lower extremity of the spindles. At DD is a third cross rail, the use of which is to contain a number of sheaves or pullies, by which the cords or bands which move the spindles are directed; and at EE appears the end of a vibrating frame, which communicates a rotatory motion to the spindles, by means to be afterwards explained. These form the principal parts necessary for the machine, the respective uses of which it may now be proper to explain at more length.

The principal part of the whole, and that to the accuracy and regularity of whose motions it will be necessary to pay the most sedulous attention, is that represented at BB and FF, or what may, without impropriety, be termed the meshing frame of the machine. In order to convey as ample and clear an idea of the nature and action of this part, it will be proper to refer to Plate CXXXIX. Figures 1, 2, 3, 4. where it is represented in various points of view, and upon a much more enlarged scale.

Construction and Use of the Meshing Frame.

In Plate CXXXIX. Figs. 1 and 2, are two vertical representations of this part of the machine, shewing the different forms which it assumes in various stages of the operation. Fig. 1 represents it in its close state; that is to say, in the way in which it appears after the formation of the mesh and the knotting to secure it are completed. Fig. 2 represents it in its open state, as it appears previous to, and during the formation of, the mesh and knotting. In Fig. 3 is given a horizontal plan of the same apparatus, necessary to elucidate some of the principles of its construction, and mode of its operation; and in Fig. 4 is given a section of the bobbins upon which the twine is wound, to explain also their particular construction and operation. This last, like Fig. 1 and 2, is a vertical representation or elevation.

In order to form the ring knot, it is well known that two twines or cords are to be laid parallel to, and in contact with, each other; that they are then turned round in a circular form, similar to that of a ring, (whence probably the name is derived,) and one end of both twines being passed through the ring, the knot is completed. This mode of knotting seems to afford a particular advantage over all others not liable to slip in this respect, that the two twines to be knotted being parallel and contiguous to each other, the requisite motions and crossings of both are precisely the same, and consequently when knotted by the aid of machinery, the process becomes more simple than where the motions of the two twines and their flextures and crossings are different. The twine of the net being wound upon bobbins, and these disposed in pairs, so that two threads may be contiguous, and the further extremities attached to the receiving beam, we are ready to commence the operation, the mesh frames being in the open state as represented by Fig. 2. It is proper to keep in mind, however, that there are four upright arms in each frame similar to those at CC, although only two are represented, the other two being at right angles to those which appear at B, which will be very plain by inspecting the horizontal plan, Fig. 3. The whole four diverging equally, form a diamond, and by passing two twines round at the points CC, a ring is formed for the knot. When the twines are thus passed round so as to form somewhat more than a circle, that part which crosses must be done below the other. If the bobbins are then raised, brought over the ring, again sunk in its centre, and pulled tight, the ring knot will be complete, and the tension of the ends will close the frame until the points meet in the centre, as in Fig. 1. The knot may be then slipped off, and the upright arms at CC will revert to the open state by their own gravity. This may be very well seen by inspecting Fig. 3. It is thus that the ring knot may be formed with the greatest accuracy and dispatch; and were the same twines always contiguous and knotted together, the operation would be simple indeed. But it is evidently necessary to complete the diagonal or diamond shape of the mesh, that the contiguity of the twines should be changed at every alternate knotting. Thus at one knotting, the twines 1 2, 3 4, 5 6, &c. (see Fig. 5.) should be contiguous, and, at the next, that 2 3, 4 5, &c. should come into contact. For this purpose some addition is necessary to the apparatus, and an idea of its construction and use will be gathered from Figs. 3 and 4, Plate CXXXIX.

In addition to the exterior apparatus or folding arms of the frame, another part is necessary, which is partially represented at L, Fig. 1, but which will be better understood by referring to Figs. 3 and 4. Fig. 3 exhibits a horizontal plan of the meshing frame and contiguous apparatus. The standards upon which the upright arms of the frame are jointed, appear plainly as quadrants of a circle at DDDD. That part of the apparatus which directs the operation of the bobbins at L, will also be distinctly seen in this figure. When the operation commences, the apparatus L, which moves horizontally on a centre, is in the situation of L 2, that is to say, just without the circumference of the meshing frame. Now let the whole apparatus of this frame revolve upon the common centre of motion, or spindle which supports it, (A, Fig. 1.) and the two contiguous twines at NN, &c. will form the ring of the knot, the arms of the meshing frame serving to keep the ring distended. The two bobbins being at the lower part of the spindle on which they revolve, will cross under the twines which are round the frame at the point near M. The bobbins are then to be raised upon the upper spindle. The cross rail, with projecting pins at O, being next shifted in a direction towards the upper part of the figure, the apparatus at L will change its position until it is right over the centre of motion, when the bobbins being let down into the centre of the ring, the knot will be formed, and the distended arms brought into contact as in Fig. 1. An inverted shift of the shaft O will then bring the bobbins again without the ring, and one series of meshes will be completed. The next operation, then, will be to change the contiguity of the bobbins for the next mesh. In order to effect this, reference may be made to the vertical section, Fig. 4. In this figure the vertical spindles are placed at a little distance, the one being perpendicularly over the other. This interval or chasm is to allow them to change freely from the outside to the inside of the ring after it has been formed, the twines passing through the interval. The lower part of the bobbin spindle A 1, moves upon the centre at D, as already described. All the upper parts at A 2 are fixed in a shaft of wood F, extending across the machine. This shaft, by means of grooves or slit holes, slides freely from side to side upon another shaft E, and this latter shaft, by means of a crank at each end, is susceptible of the same motion as that at A below, so that one may be always perpendicularly over the other. In order to guard as much as possible against those trivial inaccuracies to which machinery of every kind is in some degree liable, it may be proper to give each spindle a sharpened point, so that they may approach each other like inverted cones. If the bobbins be also countersunk at each end, there will be little danger of their missing the proper direction while shifting upwards or downwards, or presenting any obstruction to the operation. The section of B and C will serve to render this obvious. In bringing the spindles to a point, it will not be necessary that it should be very acute, for, if the bobbins are of wood, this would rather be prejudicial than of any service. A row of meshes being finished, the receiving beam is to be moved one notch off the regulating wheel, in order to wind up a portion of finished net equal to one mesh. A second row of meshes being then formed, are to be wound up as before, and so on until the whole operation is completed. From the above description a general idea of the operation may be gathered, and this is perhaps as much as can be expected without an actual model. In the next place, it may be proper to pay some attention to the general operation, and of this perhaps the most accurate idea may be formed by a regular analyses of the respective motions of the projected reticulator. Let us suppose that a mesh has just been completed, and wound up on the receiving beam, and that we are then proceeding to form a second row, the motions then will occur in the following succession:

1st, The shifting motion of the upper bobbin. At this stage of the operation, both bobbins are upon the lower spindle; but as the upper bobbin is to be shifted, those must first be lifted upon the upper one. This may very easily be accomplished, by hanging a shaft above, with a vertical motion, and furnished with wire hooks corresponding to each bobbin. If a small groove is turned in both bobbins, either one or both may be lifted at pleasure. For if the hooks lay hold of the lower bobbin, both must rise; and if, as in this case, the upper only is laid hold of, the under will not be at all affected. When the upper bobbin has been lifted, the shaft may be moved from right to left, or *vice versa*, as the case may be, and the shift completed. This operation may be effected easily by one or both of the operator's hands. This part of the apparatus is so simple, that it has not been deemed necessary to give any drawing; although this deficiency, if the experiment were to be tried, might very easily and speedily be supplied. The shift being completed, both bobbins are to be let down upon the lower spindle, and each should be furnished with a small eye to guide the twines properly round the meshing-frame. The apparatus is now ready for the second motion.

2d Motion. This is the circular revolution which the mesh-frame takes upon its own axis, carrying with it the attendant apparatus in order to form the ring. For the principle of this, of which something has been already said, reference may again be made to Drawing 1st. Fig. 1 and 2. In Fig. 1. it will be obvious that the cord which passes round the pulley at F will turn it either from right to left, or *vice versa*, every time that the shaft I is elevated or depressed. This shaft may be constructed as an oblong frame placed horizontally along the whole machine, and moveable on centres, directly behind the spindle A. Then, if that part at the left hand which appears elevated be depressed, the other end at the right will rise, and the whole spindle will turn round one, one and a quarter, or one and a half turns, as may be most convenient, and by sinking the right again, it will revert to its present position; these motions may be conveniently given by two treddles like those of a weaving loom. Thus the circular motion of the twine to form the ring may be produced.

3d Motion. Of this something has already been said, it being entirely analogous to the first motion. Both bobbins are to be lifted by a shaft and hooks, to bring them upon the upper spindle. The whole is then to be moved until the bobbins are over the centre of the ring, when they may be let down and tightened to form the knot. This being done, the spindle returns to the outside of the ring. The motions are seen very plainly in Fig. 3., both being effected merely by moving the shaft O, which may either be done by the hand or foot, as experience may show to be preferable.

4th Motion. The knot being drawn tight, is to be lifted off the points at C, (Fig. 1, 2.) which may be done by raising any of the directing shafts, without any additional apparatus. The receiving beam being then moved one notch, the operation is completed. The simplicity of these motions, and the smallness of their number, must be evidently advantageous to a practical machine, whether wrought by the operator, or put in motion by mechanical power. In particular arrangement for the former of those plans, the most efficient practical rule always is, to employ both the hands and feet of the operator, allowing as much as can be done without the inconveniency of too frequent shifting to be performed by the feet. The obvious reason of this is, that the less that the hands are employed in the production of motion, the more they will be at liberty to remove or correct casual impediments, without retarding the operation.

It will be obvious that what has been written is rather to be viewed in the light of general and leading principles, than as a detailed description. Nothing could be farther, however, from the writer's intention, than to pass any thing in a cursory or superficial way for the purpose of concealment. Experience has convinced him, that in the description of infant and speculative inventions in mechanics, it is always more safe, and certainly much more candid, merely to state principles of action in a general way, than to incur the risk of misleading others, by laying down, in a certain and didactic form, what has not yet been proved by the only infallible criterion, viz. the results of actual trial and practical experience. In the present state of the invention, what remains may be confined to general and miscellaneous remarks, and what further description is necessary to convey such an idea of the drawings as has not hitherto been given.

Figure 7. exhibits a general view of a profile elevation of the machine as viewed from the right hand. The posts are at AA; the top rail of the framing at B; the receiving roller at C; a section of the directing pins at D and and E; an elevation of the mesh frame at F; the vibrating frame which communicates the rotatory motion to the mesh frame at G; the two directing pullies at HH; one treddle at I.

Figures 8, 9, 10, 11, 12, are intended to show more clearly the adaptation of certain parts which are imperfectly represented, or omitted in the general figure.

Fig. 8. exhibits a barrel by which the rotatory motion may very conveniently be given to the mesh frame. Two cords may be attached to the wheel at B, and passing round it in opposite directions, will move the vibrating frame. From the smaller part of this barrel or cylinder at A, two similar cords will complete the connection with the treddles 1 and 2. Thus the depression of the treddle 1 will produce one motion, and that of the treddle 2 will in like manner give the inverted one. Fig. 9. is a profile of the same apparatus. Figures 10. and 11. exhibit two different ways of giving motion to the cross rails and pins for changing the mesh. In Fig. 10. this is done by a band passing over a pulley. In Fig. 11. the same is done by two inverted racks, and an intermediate pinion. The first of these will be the cheapest plan of construction, but the second is by much the most steady and certain in its operation. Fig. 12. is a plan for shifting the receiving beam to wind up the finished net. It is done merely by pulling a handle at A, a weight (not represented) being suspended from the other extremity B of the cord.

Some idea of the nature of the machine may be collected from these drawings. With regard to the expence of the construction, the writer intended to conclude this description with an estimate; but upon reflection he has been induced to postpone this, at least for the present, for the following reasons.

1st, For two very conclusive and unavoidable reasons; the first trial of every mechanical experiment is conducted at a much greater expence than what becomes necessary in a more advanced stage. It is hardly to be expected that any projector, however conversant he may be both with the theory and practice of mechanics, can at once arrange and mature a complicated and extensive body of machinery, so as both to give it the greatest possible efficiency, and construct it with the strictest attention to simplicity and economy. It is perhaps as much as ever has been effected in new machinery, if the advantage gained by its adoption be sufficient to counterbalance the difficulties to which it is exposed, and leave an ultimate profit in its favour. Hence projectors very frequently, from forming expectations more sanguine than reason will warrant, are apt to involve both themselves and others in disappointments, the more severe in proportion to the expectations which have been excited. But were the engineer capable of even much greater precision in all the minutiæ of his plan than is generally found to be the case, it would still be impossible that he could conduct his first experiments upon terms nearly equal to those which may be obtained afterwards. Every operative mechanic whom he may have occasion to employ, must have a considerable practice before he can execute his work either so perfectly or so speedily as in matured businesses. It is also impossible to allot or apportion the various departments of the work in that order and method necessary to produce that division of labour which is the very essence of every business. Upon the whole, perhaps the most economical plan is merely to try the experiment upon a very limited scale for some time, and thus to purchase that experience *which must be purchased* at as small an expence as possible. (J. D.)

CHALCEDONY. See Oryctognosy.

CHALDEA. See Babylon.

CHALK. See Oryctognosy.

CHALLENGE, (*Calumnia*) is generally understood, in common language, to signify a summons or provocation to fight a duel, in consequence of an affront offered in derogation of honour. This is considered, in law, as an offence against the peace; and, therefore, to send a verbal or written challenge, or to be the bearer of it, are punishable by fine and imprisonment, according to circumstances. The merely endeavouring to provoke another to send a challenge is also deemed a high offence; and if the challenge arise on account of money won by gaming, the offender, by Stat. 9 Ann. c. 14. shall forfeit all his goods to the crown, and suffer two years imprisonment. The Court of King's Bench frequently grant informations against persons sending challenges to justices of the peace, and in other heinous cases. See Duel.

Challenge is also a legal term, and generally signifies an exception taken against jurors, who are returned by the sheriff to pass on a trial. Challenges to jurors, in civil cases, are of two sorts, challenges *to the array*, and challenges *to the polls*. *Challenges to the array* are an exception at once to the whole panel, in which the jury are arrayed by the sheriff in his return, and may be made upon account of partiality, or some default in the sheriff or his under officer. Although there should be no personal objection against the sheriff, yet it is a good ground of challenge to the array, if he arrays the panel at the nomination, or under the direction of either party. *Challenges to the polls* are exceptions to particular jurors, and are made, 1. *Propter honoris respectum;* as if a lord of parliament be impanelled on a jury, he may be challenged by either party, or may challenge himself. 2. *Propter defectum*, on account of a suspicion of biass or partiality. This may be either a *principal* challenge, or *to the favour*. A *principal* challenge is when the cause assigned carries with it *prima facie* evident marks of suspicion: Challenges *to the favour*, on the other hand, are when only probable circumstances of suspicion are assigned, the validity of which is left to the determination of *triors*, who are two indifferent persons named by the court. 4. *Propter delictum*, on account of some crime or misdemeanour, which affects the person's credit, and renders him infamous.

Challenges upon any of the foregoing accounts are stiled challenges *for cause;* and they may be made without limitation in both civil and criminal trials. But in trials for felony, the English law, *in favorem vitæ*, allows the prisoner a *peremptory* challenge to a certain number of jurors, without shewing any cause at all. By stat. 22 Hen. VIII. c. 14. the number of peremptory challenges is limited to twenty. This privilege of peremptory challenges is denied to the king, by stat. 33 Edw. I. st. 4. It is held, however, that the king need not assign his cause of challenge till all the panel is gone through, and unless there cannot be a full jury without the persons so challenged; in which case the king's counsel must shew cause, otherwise the juror shall be sworn. In cases of high treason, the prisoner may, by stat. 7 W. III. *peremptorily* challenge thirty-five jurors.

Members of a court martial may be challenged by the prisoner on the score of partiality. The prisoner, however, must assign his cause of challenge, of the relevancy, propriety, and validity of which the members are themselves the judges. This privilege of challenge, on courts martial, is competent to the prosecutor as well as to the prisoner. See Jury. Blackstone's *Comment.* b. iii. ch. 23. and b. iv. ch. 27. Jacob's *Law Dict.* (z)

CHALONS, sur Marne, a town of France, and capital of the department of the Marne, is situated between two fine meadows on the banks of the Marne. The principal public buildings and curiosities of this place are the court-house, the principal church with its spires, the triumphal arc dedicated to Bonaparte, and the promenade called Le Jard, which is reckoned the finest in France. There is here also a botanic garden, a public library, a cabinet of natural history, and a society of agriculture, commerce, science, and the arts. A very considerable trade in corn and wines was formerly carried on in this place, but it has greatly diminished since the formation of the canal of Briare. Corn and oats, and white and red wines, are still carried to Paris, and very considerable quantities of smoked and salted bacon. There are here also several distilleries, a paper manufactory, and a nitre work. Hemp and cotton thread, hosiery goods, a kind of drab called *espagnolettes*, and several other linen and woollen stuffs, are manufactured here in great quantities. Population 11,120. (*w*)

CHALONS, sur Saone, the *Cabillonum* of the anceints, is a town in the department of the Saone and the Loire, is situated in a beautiful and fertile valley, on the right bank of the Saone. It is surrounded by walls, and defended by a citadel, and consists of the old town, the new town, and the suburbs of St Lawrence. The chief public buildings and curiosities are the principal church, the court-house, and the library or ancient college, the hospitals of Charity and St Lawrence, the dispensary, an orphan school, the public baths, and the hydraulic machine. The saloon, which contains the library, is very handsome, and the books, though in great confusion, are still numerous and valuable. It was originally composed of books left by the Jesuits, and since the revolution it has been augmented by the magnificent collection belonging to the suppressed Abbey of La Ferté. There are here two globes made of tin plate five feet in diameter, and executed by Father Legrand in 1732. The theatre, which is constructed in the late church of the Jesuits, has a wretched appearance, but the internal decorations are good. In the middle of the market place is a fountain adorned with a statue of Neptune, and there is a handsome coffee-house called the *Rondeau*, which is decorated chiefly with beautiful English engravings. The promenades are upon the quay and on the ramparts of Santa Maria, St Lawrence, and Gloriette. This town carries on a considerable trade in the wines, grain, and iron of the surrounding county, and is also the entrepot of all the merchandise which is sent from the north to the south, and from the south to the north of France. The essence of the east, which gives the peculiar colour and brilliancy to artificial pearls, is manufactured here from the scales of the bleak, (*cyprinus alburnus*) which are caught in great abundance. The *canal du centre*, which joins the Saone and the Loire, begins at Chalons and terminates at Digoin.

The remains of a Roman amphitheatre and several inscriptions attest the antiquity of this town, which is situated on the great Roman way from Lyons to Boulogne. Population 12,000. (*w*)

CHAMÆDORIA, a genus of plants of the class Diœcia, and order Hexandria. See Botany, p. 331.

CHAMÆLEON. See Mammalia.

CHAMÆROPS, a genus of plants of the class Polygamia, and order Diœcia. See Botany, p. 340.

CHAMBERLAIN, (*Camerarius*,) an officer, various in rank and in duty, according to the *chamber* or employment with which he is connected; as,

1st, *The Lord Chamberlain of Great Britain*, who is commonly reckoned the sixth great officer of the crown. The office is hereditary; and where it descends to one or more females, it is executed by deputy, who must be approved of by the king, and must not be of a degree inferior to a knight. This officer is charged with the pomp and ceremony necessary to be observed at royal coronations, and on certain other solemn occasions; to him belongs the government of the palace at Westminster; he is answerable for the due arrangements necessary for the convenience of the House of Lords in the time of Parliament; he claims livery and lodgings in the king's court, &c. and the gentleman usher of the black rod, yeoman, usher, &c. are under his authority.

2d, *The Lord Chamberlain of the Household*, who has the superintendence of all officers belonging to the king's chamber, (except the bed-chamber, which is under the groom of the stole,) and also of the wardrobe, of artificers retained in the king's service, messengers, comedians, &c. The serjeants at arms are likewise under his inspection, and the king's chaplains, physicians, apothecaries, &c. He has under him a vice-chamberlain, who, along with the chamberlain himself, are always privy counsellors.

3d, There were formerly *Chamberlains of the King's Courts*, of whom still remain *Chamberlains of the Exchequer*, who keep a controlment of the pells, of receipts and disbursements, and have in their custody the leagues and treaties with foreign princes, many ancient records, and the standards of money, weights, and measures.

4th, *The Chamberlains of London*, *Chester*, *and other cities or local jurisdictions*; the principal duty of whom, is, to receive the rents and other revenues payable into their respective chambers. (J. B.)

CHAMBERY, formerly the principal town of Savoy, but now the chief place of the department of Mont Blanc, is situated in a delightful valley, surrounded with mountains, on the left bank of the river Leisse, and upon the small river Albano. Its suburbs are large and elegant, the houses have all piazzas, and the principal public buildings are, the ancient ducal palace in the centre of the town, and the Salle de Spectacle. It is defended only by a castle placed on an eminence. The principal manufactures of Chambery are those of stockings, silk thread, works in marble, and leather. Liqueurs held in great estimation are likewise distilled here. Population in 1810, 12,000. See Tynna *Almanach du Commerce*, p. 728. (*w*)

CHAMERAPHYS, a genus of plants of the class Triandria, and order Trigynia. See Botany; and R. Brown's *Prodromus Plant. Nov. Holl. &c.* p. 19.

CHAMOIS. See Mammalia.

CHAMOUNI. This celebrated vale lies north from Mount Blanc, and south east from the lake of Geneva. The river Arve, which rises in the Col de Balme, flows through the centre of the valley. Near the middle of its course it receives the Arveiron on the left, an impetuous torrent, chiefly noted for its magnificent origin in the glacier of Bois. (See the art. Alps, vol i.) The vale of Chamouni forms but the first and smallest portion of the channel of the Arve. Upon quitting the valley through which it had winded in a south westerly direction, it takes a bend to the north, and afterwards proceeds to the north west, and enters the Rhone below Geneva. Chamouni can be approached with ease and safety only from the north; and the stations from which travellers usually commence the journey are, Geneva, and Martigni, a town situated in the west of the Vallais. The route from the latter place passes over the Tete

Noire, or the Col de Balme, (see art. Alps,) and introduces the traveller at the head of the valley. The road from Geneva winds along the banks of the Arve, and enters the valley at its southern extremity. This route, though not destitute of Alpine scenery, is less wild and picturesque than the other; but it is upon the whole a more agreeable approach, and better accommodated to the generality of travellers. From Geneva to the Priory, the distance is reckoned about 40 English miles, and can easily be travelled in one day. The roads from Geneva to Sallenche, which is considerably more than half of the journey, are well made, and accommodated to every kind of vehicle; but upon leaving the latter place, the country assumes a more alpine appearance, and the roads acquire a similar character, and can be passed only on horse-back, or in a *char a banc*. But on whatever side he approaches the valley, the view of it, when seen for the first time from some of the heights over which the road passes, throws the traveller into a kind of astonishment which cannot be expressed. He seems introduced into a new world. The majestic summits of the pointed rocks, covered with ice and eternal snow; the mountains which appear to support the sky, and whose height alarms the senses, and can with difficulty be grasped by the imagination; the striking contrast of the red colour of the primitive rocks with the dazzling white of the snow which covers them; the glaciers which descend from their lofty summits to the very edge of the valley; the beautiful variety of colours exhibited by the towers, pyramids, and obelisks, which rise from the surface of the glaciers, when illuminated by the sun; the sombre colour of the forests of fir; the pure verdure of the pasturages and meadows; the cottages, churches, and hamlets, scattered through the valley; the women and children occupied in country labour, in their garden, or before their houses, with their eye upon the flocks feeding around them; the whole forms a picture whose beauty it is easier to feel than to describe.

What is properly called the vale of Chamouni, extends from the source of the Arve to about two miles beyond the village of Ouches, and is near 18 miles in length. Its breadth no where exceeds a mile and a half, and in some places it is considerably less. The greatest portion of the valley stretches from north east to south west. About a mile, however, south from the Priory, the direction is changed to west, and afterwards to north west, by which means the traveller is prevented from seeing the whole at one view. Mount Breven, and a long range of mountains called *La chaine des Aiguilles*, form its western boundary, while on the east side rises Montanvert to the height of 2752 feet above the bottom of the valley, beautifully wooded to the top; and beyond which are seen several immense masses of perpendicular rocks, with pointed summits. From each extremity of Montanvert range other mountains of less note, which complete the eastern boundary, and between which descend those immense glaciers which form one of the most striking features of this interesting scene. All the glaciers enter the valley on the eastern side, and in the following order, viz. Taconna at the southern extremity, opposite the village of Ouches; Bossons Montanvert, between the mountain and a range of pointed rocks; Bois, near the source of the Arveiron; Argentiere and Tour, near the source of the Arve.

When we consider the great elevation of the valley above the level of the sea, (3354 feet,) and the immediate neighbourhood of those immense masses of ice and snow, it is somewhat surprising, that its mean temperature should seldom be more than 10° or 11° below that of Geneva. Bourrit gives the following state of the thermometer as the average temperature of the summer:—at nine in the morning, 52 degrees Fahrenheit; at mid-day, 66; and in the evening, 57. This uncommon mildness of the climate may be in some measure owing to the general tendency of vallies to concentrate the rays of the sun; but more, perhaps, to the particular direction of the valley, by which it is exposed for near ten hours in summer to the direct action of the sun's rays. The climate, however, even in summer, is very variable. Saussure states, that on the 25th of July, at noon, in the shade, the thermometer rose to 77 degrees; while on the 22d of the same month, it was only 66; and in the morning of the 23d there was a strong hoar frost. The fine season usually commences in June, and ends in September; though October, and even November, are sometimes agreeable months. Winter, in general, begins in November, and ends in May. During that time, the valley is completely covered with snow to a considerable depth; the nights are clear; and the thermometer often falls to 22 degrees below the freezing point. While this dreary season continues, the inhabitants seldom go abroad, the women occupy themselves in spinning, and the men in attending to the cattle.

The following remarks of Saussure will enable the reader to form some idea of the length and severity of the winter. "I arrived at Chamouni," says he, "on the 24th of March, and found the whole valley covered with snow. At the Priory it was a foot and a half deep, at Argentierē four feet, and at Tour twelve feet. The heat of the sun softened the snow in the day-time; but it froze again during the night to such a degree, that loaded mules passed over it without leaving any impression of their feet." The appearance of the valley at this season is grand, but by no means interesting. The immense space between the summits of the mountains and the bottom of the valley, presents one uniform white surface, unbroken except by some rocks, whose steep sides cannot retain the snow. The forests have a greyish hue, and the Arve, which winds through the centre of the valley, appears like a black thread. The glaciers, which add so much to the beauty of the landscape, when the valley is clothed in green, produce no effect in the midst of all this white; but the pyramids of ice, whose steep sides have remained bare, appear like emeralds under the fresh white snow which covers their summits. The whole prospect, when illuminated by the sun, has, with all its grandeur and dazzling light, something dead and melancholy. The severity of the winter, and the shortness of the summer, which scarcely allows sufficient time for the labours of the field, render it highly important to hasten, if possible, the melting of the snow. The contrivance used for this purpose by the inhabitants of the higher part of the valley, is both simple and elegant, and attended with small expence. It consists in scattering black earth on the top of the snow, which, by absorbing more of the sun's rays than the white surface, facilitates the clearing of the fields, and advances the labours of agriculture about three weeks.

Their chief crops are flax, barley, oats, beans, and potatoes. Flax succeeds better in the valley than in the open country, and the potatoe crop is uncommonly productive. No wheat is sown except on some small spots in the bottom of the valley, and no more corn is raised than what is necessary for the consumption of the inhabitants. Their principal crop is hay for the cattle during winter. Every proprietor divides his lands into two equal portions; the one half is laid out in corn fields, the other in meadows. This arrangement continues for six years, after which the meadows are ploughed up, and the corn fields converted into meadow. The whole of the bottom of the valley is laid out in this manner. But the chief source of their wealth arises from the pasturages among the mountains. The wealthier peasants have meadows, and even dwelling houses at different heights. They live in the lower part of the valley during winter; but at the approach of spring they quit their winter habitations, and ascend gradually to the more elevated pasturages, following the progress of vegetation. At the approach of autumn they re-descend by the same gradations, and thus pass the summer in a pleasant and varied style, enjoying a perpetual spring. Besides the pasturages, which are private property, there are others common to all the inhabitants of the valley. These commons are very valuable to the middling ranks of the community; but it is much to be regretted that the poorer sort, for whose benefit they are chiefly intended, cannot avail themselves of the advantage. For not only is money required to purchase cows, but it is also necessary to have the means of supporting them during the winter; and though by collecting the dried leaves of the ash tree, and by cutting hay in the unfrequented parts of the mountains, it is possible for one man to maintain a single cow during the winter; yet this is nothing compared to the advantage gained by those who possess a few acres of meadow land, and can send six or seven cows to the common pastures. Their cattle, as we formerly observed, is the chief source of their wealth. It is by the sale of their butter and cheese that they are furnished with the means of purchasing foreign luxuries, and those necessaries and conveniences which even their simple style of life requires. Next to cheese, the most valuable production of the valley is honey. It is of a pure white colour, and has a brilliant grain resembling sugar. It has an exquisite taste, and an aromatic odour. It is sold in little barrels which cost a crown a piece. It has long been a puzzling enquiry how the honey of Chamouni acquires those peculiar properties. The bees are the same as those of the neighbouring villages, and the hives of Chamouni are often recruited from them, and yet, beyond the precincts of the valley, the honey is not distinguished by any of those peculiar qualities. Saussure conjectures that it may be owing to the larch trees which abound in Chamouni, the leaves of which exude, at certain seasons, a kind of manna, in which the bees take great delight. Though the profit arising from the culture of bees in the valley is very considerable, yet the trouble and risk are proportionally great, arising not only from the length and severity of the winter, but chiefly from the too early appearance of fine weather, which tempts the bees to go abroad before the valley is cleared, by which means they die among the snow, or, if forcibly detained, destroy one another in the hive.

Honey is perhaps the only native luxury of which Chamouni can boast. Fruit of any kind is rarely met with, and the vine is entirely unknown. The apples, cherries, and plums, which grow there, are all of the wild kind, and seldom arrive at maturity. The oak, the chesnut, and walnut tree, are never seen.

The population of the valley is very considerable for its extent. If we were to judge, however, of the number of the inhabitants, from the crowds which appear in every village upon the arrival of a stranger, we should form rather too high an estimate of its population, for on those occasions, every male person in the district presents himself, in the expectation of being hired as a guide. The valley is divided into three parishes; Ouches, in the south west; Argentiere, in the north east; and the Priory in the middle. Bourrit, who visited the country about 30 years ago, gives the following statement of the population, viz. 300 in the district of Vaudagne, 1000 in the parish of Ouches, 1200 in the Priory, 500 in Argentiere. It is probable that since that period the number of the inhabitants has considerably increased, for even then the progress of population was very discernible, owing no doubt to the great influx of strangers from all parts of Europe during the summer months—a practice which had begun only a few years before Bourrit wrote, and which, it is likely, has since that time become more general, unless checked, perhaps, by the present disturbed state of the continent. The effect of these visits upon the industry of a people secluded from the world, like those of Chamouni, must obviously be very great, not only by circulating a quantity of money, and exciting a new demand for the productions of the valley, but by improving the roads, and opening, as it were, a direct communication with foreign countries. Accordingly Bourrit remarks, that those who a few years prior to his arrival had only three or four hives of bees, had then 40, that cheese and butter, which had formerly been made for home consumption only, was then a great article of exportation; that woods, which used to rot on the place where they grew, had been cut down, and the land cleared and converted into corn fields and meadows; that small and very inconvenient houses had been replaced by others more spacious and airy, and consequently more healthy.

It is to be feared, however, that these occasional visits of strangers sometimes produce the very opposite effect, by leading the people to prefer the high, but precarious profits of being hired as guides, to the more slow but sure gains of regular industry. Hence we find a spirit of enterprise, and a desire of acquiring sudden wealth, the great spring of all their pursuits. For while the whole labours of the field devolve upon the women, not even excepting those severe labours, which in other countries are always the peculiar province of the other sex, as ploughing the fields, cutting the woods, mowing the hay, and threshing the corn; the men are employed as guides in searching for crystals, in hunting the chamois, or in discovering the lurking places of the marmot. (For a minute and interesting account of all these occupations, we refer our readers to Saussure.) The same love of gain induces the remaining part of the male population to go abroad to Paris and the cities of Germany, or to hire themselves during the summer months to the people of the Tarentaise and the valley of Aosta, for the purpose of making cheese, in which they are said greatly to excel. Even their winter amusements have something of the same character, especially in the large villages, where the men, perhaps for want of some employment to occupy their active minds, pass the greater part of their time in taverns, and play at games of hazard, in which they have sometimes been known to risk their whole property. In the small hamlets, however, the winter evenings are spent in a different manner. The whole village assemble in the house which has the largest room with a fire. The women spin, dress flax, and tell stories; while the men occupy themselves in making milk-pails, spoons, and other utensils in wood. The mistress of the house is at no other expence for their entertainment than a pitcher of water and a basket of wild apples, which are roasted under the ashes.

The men of Chamouni are of a middle stature, stout, and active. They have a lively and penetrating air, and a gay character, inclined to raillery. They are in general honest, faithful, religious, and particularly distinguished for acts of charity and beneficence. They have no hospitals or foundations in behalf of the poor; but the old men and orphans, who have no means of subsistence, live at the houses of the inhabitants of the parish in regular succession. The government of the valley is that of a small republic, and is entrusted to a register, a syndic, and seven councillors. The chapter of Sallenche enjoys the sovereignty in all ecclesiastical matters; names the curates, and draws the church revenues. The curate of the priory has the title of administrator, because, besides possessing the cure of souls, he has also the management of the temporalities of the chapter. (*s*)

CHAMPARTY, (*campi partitio*,) in English law, an offence against public justice, whereby the champertor engages to carry on, at his own expence, the suit of the plaintiff or defendant, on condition of having the land, or other property in dispute, divided between them in the event of success in the suit. It is a species of *maintenance*, or the undue encouragement of law suits, to the oppression and disturbance of the honest and peaceable. Like that offence, it is punished at common law by fine and imprisonment, and by statute 32 Hen. VIII. c. 9. by a forfeiture of ten pounds. Such avaricious or malignant disturbers of other men's quiet, have been regarded as proper objects of chastisement by the laws of every well regulated state, and particularly by those of ancient Rome, which enact, *qui improbe coeunt in alienam litem, ut quicquid ex condemnatione in rem ipsius redactum fuerit, inter eos communicaretur, lege Julia de vi privata, tenentur*; and accordingly perpetual infamy, with the forfeiture of a third part of their goods, was the consequence of a conviction. (J. B.)

CHAMPION, he who undertakes to maintain, by single combat, his own right or that of another. By the law of England, a species of trial was formerly in use, known by the name of *wager of battel*, a rude mode of terminating disputes practised by most barbarous nations. In this judicial combat, the parties appeared either themselves, or (as came afterwards to be more usually the case) by their champions, having their armour on, and attended with every circumstance of pomp and ceremony that could give dignity to the spectacle. The weapons used were more or less dangerous, according to the nature of the cause, as military, civil, or criminal. The consequences likewise, even when the unsuccessful combatant escaped unhurt, were more or less serious, both to the champion himself and his principal. If the champion of a woman, charged with a capital offence, was overcome, or proved *recreant*, the woman was burnt, and her champion hanged; and so with regard to smaller offences. Principals seem originally to have been allowed to wage their battle from casualties of sex, nonage, or other excusable disability; but as the better ranks became more effeminate, or wise, proxies came to be allowed in all cases, being either retained as a standing officer among the great lord's other dependents, or hired for the special occasion.

The *king's champion* is an officer still employed at the coronation of our kings, as a relic of the ancient manner of that solemnity. In the true spirit of the *wager of battel*, he rides armed *cap-à-pie* into Westminster Hall, where the king is at dinner, and makes challenge by proclamation of a herald, That if any man shall deny the king's title to the crown, he is there ready to defend it in single combat. The office is hereditary. (J. B)

CHAMPLAIN LAKE. See CANADA.

CHANCELLOR, a judicial officer, who appears originally to have been only a principal register or scribe under the emperors; but in modern times has greatly advanced in dignity, having become, in different kingdoms of Europe, the chief administrator of justice. The name has also been extended to a variety of inferior officers, but all of them of a judiciary character; as chancellor of a diocese, or of a bishop; chancellor of a university, of the exchequer, &c. Its etymology, as in so many other instances, is disputed; some deriving it from *cancelli*, because anciently the *cancellarius* is said to have sat within an inclosed place, or *lattice*, to protect him from the press of persons who had occasion to transact business with him: others preferring *cancellare*, to delete or cancel, because, as the highest point of his jurisdiction, he has the right of cancelling, by his own proper authority, the king's letters patent, when granted contrary to law; an etymology, however, which is plainly inconsistent with the originally subordinate nature of the office.

The *Lord High Chancellor of Great Britain* is the chief magistrate in the judicial establishment of the country. He takes precedence of the nobility, and also of all the spiritual lords, except the Archbishop of Canterbury. The office is, in later times, conferred by his majesty merely delivering the custody of his great seal; and is, in like manner, determined by the seal being resumed or resigned. It implies a very high, and, in many respects, an undefined authority in its *judiciary* capacity; and comprehends, besides, certain *political* dignities. With regard to the former, though all other judges in England are bound to give judgment by the strict rules of law, yet the chancellor, like the ancient prætors, has power to mitigate the severities which would otherwise frequently arise from its undistinguishing dictates, and to regulate his decisions *secundum aequum et bonum.* Or, in the words of Staundford, the chancellor has two powers, one absolute, the other ordinary; meaning, that although, by his ordinary power, he must, in some cases, observe the form of proceeding as other judges, in his absolute power he is not limited by the law, but by conscience and equity, according to the circumstances of things. Besides this exclusive jurisdiction which he exercises in his court of chancery, the justices of the peace throughout the kingdom are of his appointment. And having been formerly, for the most part, an ecclesiastic, when few else could be found sufficiently learned for the office, he presided over the royal chapel, and became what is called *Keeper of the king's conscience*, a phrase, as we understand it, which implies that he was a sort of chief confessor to the king, or the expounder of his casuistical difficulties on points of religion and justice. He is also visitor, in right of the king, of all hospitals and colleges of the king's foundation, and patron of all the king's livings under the value of twenty merks a-year in the king's books. He is, besides, the general guardian of all infants, ideots, and lunatics, and has the general superintendence of charitable uses. With regard to his *political* dignities, the principal seem to be that of being a member of the privy council, in virtue of his office, and also, (according to Lord Ellesmere,) of being prolocutor of the House of Lords.

Previously to the statute 5 Eliz. c. 18, the chancellor and *lord keeper* were distinct officers, having different powers; but by that statute both officers are declared to have one and the same power, so that there cannot, since that statute, be a lord keeper and a lord chancellor at the same time.

With regard to the variety of inferior officers to whom the appellation of *chancellor* has, in modern times, been extended, we cannot take room to detail any part of their different local or subordinate jurisdictions and dignities. The principal officers so denominated are, the *chancellor of the exchequer*, who manages the royal revenues, and, along with the treasurer, chief baron, and other judges, presides in the court of equity held in the exchequer chamber; *chancellor of the order of the garter*, and *of other military orders; chancellor of the duchy of Lancaster; chancellors of universities; chancellors in cathedral churches;* and *chancellor of a diocese*, or *of a bishop*. See Selden's *Discourse touching the Office of Chancellor;* Blackstone's *Comm.* &c. (J. B.)

CHANCE-MEDLEY, (Fr. *chance*, lapsus, and *meler*, miscere,) in the criminal law of England, is the lowest species of homicide to which punishment attaches. It consists in killing a human being in *self-defence*, upon occasion of any *sudden* (chance) quarrel. The self-defence must, of course, be real, and after every other expedient for self-preservation has failed, else the offence will rise to a manslaughter. The offence differs from homicide by *misadventure* in this, that the latter takes place in the course of a lawful act, where there is no intention of doing hurt; as if a man is at work with a hatchet, and the head of it fly off and kill a stander-by, whereas the former is intentional, but necessary for the killer's own preservation. And they agree in this, that the law presumes the *occasion* of the killing might have been avoided in both cases; in the one by greater care in the choice and use of the instrument; in the other, by avoiding the quarrel altogether, which required so fatal a termination. The law, therefore, does not hold it as a *justifiable* homicide, but, along with killing by misadventure, distinguishes it with the less exculpatory term of excusable. Anciently the punishment was severe; according to some writers no less than death. It appears afterwards to have been reduced to the more equitable forfeiture of a certain portion of the delinquent's goods and chattels; and now, of a considerable time, it has been the practice for the judge to direct an entire acquittal where the jury cannot convict of at least a *manslaughter*.

The word *chaud-medley* is sometimes used in place of chance-medley. They are nearly of the same import; the only difference, which arises merely from the etymology, being, that the former is critically applicable, when reference is more particularly made to the *heat* of blood or passion in which the killing takes place; the latter, when it is to the *casual* or accidental nature of the rencounter. In common language, *chance-medley* is made to comprehend homicide by *misadventure;* but it is distinguished both by statute and law writers from every killing of that nature, by the circumstance of self-defence, in the manner we have explained. (J. H.)

CHANCERY, (*cancellaria*,) the high court of judicature, in which the lord chancellor, in his judicial character, exercises his very extensive authority. It is of great antiquity, and is inferior only to the parliament in point of dignity and power. Its jurisdiction is twofold, and is commonly distinguished into *ordinary* and *extraordinary*. Each of these forms a distinct tribunal, the former being governed by the rules of common law, the latter by those of equity. In the ordinary or common law court are held such pleas as, the king being a party to them, are remediable at common law, but by supplication to himself in the person of his chancellor. Of this kind are, plea upon a *scire facias*, "which is held," to use the words of Blackstone, "to repeal and cancel the king's letters patent when made against law, or upon untrue suggestions; plea of petitions, *monstrans de droits;* traverses of offices, and the like, when the king has been advised to do any act, or is put in possession of any lands or goods in prejudice of a subject's right; on proof of which, as the king can never be supposed to do any wrong, the law questions not but he will immediately redress the injury, and refers that conscientious task to the chancellor, the keeper of his conscience. In this ordinary court," continues the same writer, "is kept the *officina justitiæ*, from which issue all original writs that pass the great seal, all commissions of charitable uses, sewers, bankruptcy, idiotcy, lunacy, and the like; and for which it is always open to the subject, who may there at any time demand and have, *ex debito justitiæ*, any writ that his occasions may call for." The *extraordinary* court, on the other hand, proceeding by the rules of equity, softens the rigour, but by no means opposes the spirit, of the common law, in those cases where, by reason of the unavoidable generality of that law, manifest injustice would result by its undistinguished application. Accordingly, this court interposes in all cases of frauds, deceitful or rash engagements, &c. which admit not of remedy at common law. It gives relief in the case of minors, *against* as well as for them; of married women pending their coverture, and in certain suits at their instance against their husbands; of breach of trust; loss of titles to lands, &c.

Without, however, attempting to elucidate further the nature of the jurisdiction of this high court, or to enumerate the variety of pleas to which it is competent, (a task which has puzzled the ablest writers, even when free to investigate the subject in the fullest manner,) we shall content ourselves with one or two general observations on this and other courts of equity, taken from a modern treatise of respectable character. "Early in the history of our jurisprudence," says Mr Mitford, in his work *on the Pleadings in Chancery*, "the administration of justice by the ordinary courts appears to have been incomplete. To supply the defect, the courts of equity have gained an establishment; assuming the power of enforcing the principles upon which the ordinary courts also decide, when the powers of those courts, or their modes of proceeding, are insufficient for the purpose; of preventing those principles, when enforced by the ordinary courts, from becoming, contrary to the purpose of their original establishment, instruments of injustice; and of deciding on principles of universal justice, where the interference of a court of judicature is necessary to prevent a wrong, and the positive law is silent. The courts of equity also administer to the ends of justice, by removing impediments to the fair decision of a question in other courts; by providing for the safety of property in dispute, pending a litigation; by restraining the assertion of doubtful rights, in a manner productive of irreparable damage; by preventing injury to a third person from the doubtful title of others; and by putting a bound to vexatious and oppressive litigations, and preventing unnecessary multiplicity of suits; and, without pronouncing any judgment on the subject, by compelling a discovery which may enable other courts to give their judgment; and by preserving testimony, when in danger of being lost, before the matter to which it relates can be made the subject of judicial investigation. This establishment has obtained throughout the whole system of our judicial policy; most of the inferior branches of that system having their peculiar courts of equity, (*e. g.* the court of exchequer, courts of *Wales*, the counties palatine, cinque ports, &c.) and the court of chancery assuming a general jurisdiction in cases which are not within the bounds, or which are beyond the powers of other jurisdictions." See Tomlin's *Jacob's Law Dictionary;* Blackstone's *Comm.;* and Mitford's *Treatise on Pleadings in Chancery*, &c. (J. B.)

CHANCES.

1. The doctrine of chances, considered as a mathematical theory, treats of the probability of the happening of such events as cannot be accurately predicted, either on account of our being ignorant of their precise causes, or else because the number of circumstances to be taken into account, in estimating the effects of those causes, is too great to be fully comprehended by the human mind.

This theory treats particularly of the chances of play, in such games as depend on circumstances beyond the controul of the players. Of this nature are lotteries, and all games depending on the throwing of dice, or shuffling of cards. It is also applicable to certain moral and political events; such as the credibility of human testimony, and the decision of questions by a majority of votes; but one of its most valuable applications is to the resolution of questions depending on the probability of the duration of human life; a subject which is become of the highest importance to individuals, as well as to communities, on account of the great number of life insurances, annuities depending on lives, benefit societies, &c. which are now so common.

2. This branch of the mathematics is entirely modern, it having been first cultivated by Pascal and Fermat about the middle of the 17th century. The following problem was one of the earliest that engaged Pascal's attention, and was proposed by him to Fermat: "Two persons sit down to play for a certain sum of money, and agree, that he who first gets three games shall be the winner. One of them has got two games and the other one, but being unwilling to continue their play, they resolve to divide the stake: how much should each receive?" Fermat resolved the problem by the method of combinations, but Pascal had previously found out its solution by a different method.

3. The researches of these mathematicians on this subject remained for many years among their papers; and in that interval Huygens, having heard probably of what had passed between them, turned his attention to the subject, and composed his work, *De ratiociniis in Ludo aleæ*, which Schooten published for the first time in 1658, at the end of his *Exercitationes Mathematicæ*. The rudiments of the theory were here demonstrated for the first time; and this was nearly all that was done previous to the middle of the 17th century; hardly any thing having been added during the remainder of it, if we except a short paper by Saveur on the game of *Bassette*, inserted in the *Journal des Savans* (1679), a letter on the game of *Tennis* by an anonymous writer, and another small anonymous tract *On the Laws of Chance*, published at London in 1692.

4. The celebrated James Bernoulli is the next writer whose labours require to be particularly noticed. He began by proposing the following problem in the *Journal des Savans* for 1690: "Two persons, A and B, play with a die; the condition is, that whoever gets a certain number of points first, wins the game. A begins by throwing the die once; then B throws it once. A next throws the die twice; afterwards B throws it twice: then A three times, and B three times, and so on. What is the ratio of their respective chances of winning?" The problem remained without an answer, until its ingenious author gave one in the *Leipsic Acts* for 1690. This called the attention of Leibnitz to the same subject, who gave also a solution in the same *Acts*. Bernoulli was now preparing his *Ars Conjectandi*, a work which, besides such questions as were agitated by Pascal and Fermat, contains a multitude of others, increasing in difficulty. He has also attempted to apply his theory to moral and political events. He died, however, before he could give his labours the degree of perfection he wished for; and they did not appear until the year 1715, when they were published by his nephew Nicolas Bernoulli, who had himself treated of the same theory in the *Leipsic Acts* for 1711, in a memoir called *Specimina artis conjectandi ad questiones juris applicatæ*.

5. In the interval between the completion of James Bernoulli's discoveries and their publication, the theory of chances was handled by two excellent mathematicians, *Montmort* and *De Moivre*. The first of these turned his attention to the subject, with a view to compensate for the loss of Bernoulli's labours, in the event of their never being published. De Moivre began by communicating to the Royal Society, in 1711, a memoir entitled, *De Mensura sortis*. He afterwards published, in 1716, his *Doctrine of Chances*, a work justly regarded as one of the most valuable that has ever appeared on the subject. The best edition is the third, printed in 1756, together with his *Treatise of Annuities on Lives*. His *Miscellanea Analytica* also contains some disquisitions on the same subject.

6. Mr Thomas Simpson has likewise treated of this subject, in a work called the *Nature and Laws of Chance*, first published in 1740. This treatise is concise, and at the same time perspicuous, and, like the ingenious author's other writings, is remarkable for its originality.

This curious branch of science has also been more or less cultivated by most of the eminent mathematicians of the last century; as by John Bernoulli, Euler, Cramer, D'Alembert, Beguelin, &c.; and at a latter period by Condorcet, in his *Essai sur l'application de l'analyse aux decisions qui se donnent a la pluralite des voix*.

7. The application of the doctrine of chances to questions connected with political economy, is by far the most

interesting branch of this theory. The subject of Life Annuities, in particular, is highly important. Van Hudden, and the celebrated pensionary of Holland, De Witt, appear to have been the earliest who considered it; and Sir William Petty also turned his attention to it, but without any degree of success, probably on account of his want of mathematical knowledge. Dr Halley was the first who made any considerable progress in its improvement, by constructing tables of the probability of human life, from a comparison of the bills of mortality of Breslaw in Silesia. De Moivre carried on what Dr Halley had begun; and Simpson greatly contributed to the perfection of the theory. The labours of Dodson, the friend of De Moivre, are also justly entitled to notice; in his *Mathematical Repository*, the subject of annuities, as well as the doctrine of chances in general, are treated with great clearness, and in a manner well suited to persons having but an ordinary share of mathematical knowledge. Indeed, we have freely availed ourselves of his labours in the compilation of the brief view we here give of the subject.

We shall now explain some of the more useful parts of this theory, and exemplify the mode of reasoning it requires by a series of problems.

PROBLEM I.

8. Suppose a circular piece of metal having two opposite faces, the one white and the other black, is thrown up, in order to see which of its faces will be uppermost after it has fallen to the ground. When, if the white face be uppermost, a person is to be entitled to 5*l*., or any other sum of money; it is required to determine, before the event, what chance or probability that person has of receiving the 5*l*.; and what sum he may reasonably expect should be paid to him, in consideration of resigning his chance to another person?

SOLUTION.—Since by supposition there is nothing in the shape of the metal to determine one face to come up rather than the other, there is an equal chance for the appearance of either face; or in other words, there is one chance out of two for the appearance of the white face. Therefore, the *probability* that it is uppermost may be expressed by the fraction $\frac{1}{2}$. And if any other person should be willing to purchase this chance, the proprietor may reasonably expect $\frac{1}{2}$ of 5*l*. in consideration of his resigning his chance thereof.

PROBLEM II.

9. Suppose there are three cards, each of different suits, viz. one heart, one diamond, and one club, laid on a table with their faces downward, out of which, if a person at one trial takes the heart, he is to be entitled to 5*l*., or any other sum of money. It is required to determine, before the event, what chance or probability he has of winning and missing the said 5*l*.; and what sum he may reasonably expect to be paid to him, in consideration of his resigning his chance to another.

SOLUTION.—Since it is supposed that there is nothing in the external appearance of the cards to induce the person to choose one rather than another; and since he is to have but one choice, it follows that he has but one chance in three for obtaining the money: therefore the probability of his getting it may be expressed by the fraction $\frac{1}{3}$. Again, since two cards remain after he has had his choice, either of which may be the heart, there are two chances out of three that he will miss it; and the probability thereof may be expressed by the fraction $\frac{2}{3}$. Lastly, he may reasonably expect $\frac{1}{3}$ of 5*l*. as a consideration for transferring his chance to another.

PROBLEM III.

10. Suppose that there are five counters, of which four are black and one white, out of which, being mixed together, a person blindfolded is to draw one, and is to be entitled to 5*l*., or any other sum of money, if he happens to draw the white counter. It is required to determine, before the event, what chance he has of winning and of missing the said 5*l*.; and what sum he may reasonably expect, upon transferring his chance to another.

SOLUTION.—By reasoning in this as in the two foregoing problems, it will appear, that the person has only one chance in five of obtaining the 5*l*., and four chances out of five for missing it; therefore, the probability of his obtaining it may be expressed by the fraction $\frac{1}{5}$; and the probability of his missing it by the fraction $\frac{4}{5}$. And he will be entitled to $\frac{1}{5}$ of the 5*l*., if he transfers his chance to another.

PROBLEM IV.

11. Suppose there are five counters, three black, and the other two white; out of which, when mixed together, a person blindfolded is to draw one, and is to be entitled to five pounds, or any other sum, if he happens to draw either of the white ones. It is required to determine, before the event, what chance or probability he has of winning, and missing, the said five pounds; and what sum he may reasonably expect to be paid to him for resigning his chance to another.

SOLUTION.—In this case the person has manifestly only two chances out of five for taking a white counter, and three for taking a black one: Therefore the probability of winning may be expressed by the fraction $\frac{2}{5}$, and that of missing by the fraction $\frac{3}{5}$: Also he ought to receive $\frac{2}{5}$ of the five pounds if he parts with his chance to another.

12. What has been said in these four problems concerning cards, counters, &c. may easily be conceived to extend to any other things which are the objects of chance. For instance, if, at the conclusion of the drawing of a lottery, there should remain in one wheel five tickets or numbers only, and in the other, two equal prizes and three blanks; then, the possessor of one of these tickets would be exactly in the situation of the person mentioned in the last question.

In general, if the number of blanks in a lottery be represented by m, and the number of prizes by n, then the probability of having one prize with one ticket will be $\frac{n}{m+n}$; and the probability of having a blank $\frac{m}{m+n}$. From which it appears,

I. *That the probability of the happening of any event, considered as resulting from chance, may be expressed by a fraction, whose numerator is the number of chances for the happening of the event, and the denominator is the number of all the chances whereby it may both happen and fail. And the probability of such an event's failing, may be expressed by a fraction whose numerator is the number of chances for its not happening, and denominator the same as that of the former fraction.*

II. *The sum of the two fractions representing the probability of the happening and the failing of an event is equal to unity: Therefore, when one of them is given, the other may be found by subtraction.*

III. *The* expectation, *that is, the sum which the person who has a chance for the happening of an event is entitled to, if he resign his chance to another, is always the product of the fraction representing the probability multiplied into the sum expected:* Therefore, if that sum be denoted by unity, the expectation will be denoted by the probability itself: Or, in general, if the *expectation* of an event be divided by the value of the thing expected, the quotient will express the *probability* of the event.

PROBLEM V.

13. What is the probability that a person playing with a single die throws an ace each time for two successive throws?

SOLUTION.—Suppose that the person is to receive 1*l.*, provided he succeeds in throwing an ace each time. Now, if an ace were to come up the first time, then, because the die has six faces, only one of which is favourable to him, his *expectation* on the second throw would be $\frac{1}{6}\times 1l.$, (Art. 12.) But we may consider the first event, viz. the throwing an ace the first throw as the condition of obtaining this sum $\frac{1}{6}\times 1l.$; and the probability of this event being also $\frac{1}{6}$, the expectation before the first throw must necessarily be $\frac{1}{6}\times\frac{1}{6}\times 1l.$, (Art. 12.); and as in this case the probability is expressed by the same fraction as the expectation, the probability of throwing an ace each time for two successive throws is $\frac{1}{6}\times\frac{1}{6}=\frac{1}{36}$.

Corollary.—As it is evidently the same whether a single die be thrown twice successively, or two dice be thrown at once; therefore, the probability of throwing two aces (or any given face) at one throw with two dice, is also expressed by the fraction $\frac{1}{6}\times\frac{1}{6}=\frac{1}{36}$.

PROBLEM VI.

14. A person offers to lay a wager of 1*l.*, that out of a purse containing $m+n$ counters, whereof m are black, and n white, he will, blindfolded, at the first trial, draw a white counter; and also, that out of another purse containing M+N counters, whereof M are black, and N white, he will also at the first trial draw a white counter, and that if he fails in either trial his wager shall be lost. It is required to determine the probability he has of succeeding therein.

SOLUTION.—If, as in the last problem, we suppose he has already succeeded in the first trial, then it will follow, as has been there explained, that his expectation on the second will be $\frac{N}{M+N}\times 1l.$, or simply $\frac{N}{M+N}$. And if, as in the same problem, we consider the success of his first trial as the condition of obtaining this expectation, then its probability will be $\frac{n}{m+n}$; which multiplied into that expectation, will give $\frac{n}{m+n}\times\frac{N}{M+N}$ for the probability required. Hence it appears, *that the probability of the happening of two independent events is equal to the product of the probabilities of their happening separately.*

Cor. If the two events are both of the same kind, then the probability will be $\frac{n^2}{(m+n)^2}$.

PROBLEM VII.

15. A person offers to lay a wager of 1*l.*, that out of a purse containing $m+n$ counters, of which m are black, and n white, he will draw, blindfolded, at the first trial, a black counter; and also, that out of another purse containing M+N counters, of which M are black, and N white, he will also draw at the first trial a white counter; and if either experiment fail he is to lose his wager. What is the probability of his succeeding?

SOLUTION.—By reasoning as in the last problem, it will appear, that the probability is expressed by $\frac{m}{m+n}\times\frac{N}{M+N}$: But we may also understand this problem to mean, that he is to fail of drawing a white counter at the first trial, and to succeed in the second: Now, the probability of drawing a white counter the first trial being $\frac{n}{m+n}$, that of failing will be $1-\frac{n}{m+n}$, (Art. 12.); and the probability of succeeding in the second trial being $\frac{N}{M+N}$, the product of these two fractions, or $\left(1-\frac{n}{m+n}\right)\times\frac{N}{M+N}$, will be the probability required, (Art. 14.)

In like manner it appears, that the probability of failing in both experiments is the product of the probabilities of their failing separately, viz.

$$\left(1-\frac{n}{m+n}\right)\times\left(1-\frac{N}{M+N}\right).$$

Cor. If the events be both of the same kind, the probability of failing in the first trial, and succeeding in the second, will be $\left(1-\frac{n}{m+n}\right)\times\frac{n}{m+n}$, and that of failing in both $\left(1-\frac{n}{m+n}\right)^2$.

16. We may deduce the probability of the happening of three independent events from that of two, and the probability of four from that of three, and so on, by reasoning as follows: Suppose that the receiving of a sum of money, as 1*l.*, depends on the happening of three events, the probabilities of which are $\frac{a}{b}, \frac{c}{d}, \frac{e}{f}$, respectively. Then, if the two first events had actually happened, so that the receiving of the sum depended on the third event only, the value of the expectation on that event would be $\frac{e}{f}\times 1l.$, (Art. 12.) Therefore we may consider $\frac{e}{f}\times 1l.$ as a sum to be received, provided the two first events happen. Now, we may regard the happening of the first two as a single event, the probability of which is $\frac{a}{b}\times\frac{c}{d}$, (Art. 14.); therefore the value of the expectation on all the three is $\frac{a}{b}\times\frac{c}{d}\times\frac{e}{f}\times 1l.$, and the probability of their happening is $\frac{a}{b}\times\frac{c}{d}\times\frac{e}{f}$, (Art. 12.)

In general, whatever be the number of independent events, *the probability of their all happening is equal to the continual product of their separate probabilities.*

PROBLEM VIII.

17. What is the probability of throwing with a single die one ace, or more, in two throws, that is, either at the first or second throw, or at both?

SOLUTION.—In this problem, we may consider the probability required as made up of two other probabilities, viz. that of throwing an ace at the first throw, and that of missing it at the first throw, and throwing it at the second: Therefore, if we estimate these separately, their sum will be the probability required.

In order to render the conclusion general, let 6 (the number of faces of the die) $=n$. Then the probability of throwing an ace at the first throw is $\frac{1}{n}$; and that of missing it, $1-\frac{1}{n}=\frac{n-1}{n}$. Also the probability of throwing an ace at the second throw is $\frac{1}{n}$; and, connecting this with the probability of missing it the first trial, we have the probability of missing it at the first trial and throwing it the second, expressed by $\frac{n-1}{n}\times\frac{1}{n}$, (Art. 14.) Therefore the probability required is $\frac{1}{n}+\frac{n-1}{n^2}=\frac{2n-1}{n^2}=\frac{n^2-(n-1)^2}{n^2}=\frac{11}{36}$.

This problem may also be resolved by considering, that the probability of missing an ace twice, together with the probability of throwing an ace either at the first or second throw, must amount to certainty, which is measured by 1: Therefore, if we estimate the former of these probabilities, and subtract it from unity, the remainder must be the latter. Now, the probability of missing an ace at the first throw is $\frac{n-1}{n}$, (Art. 12.) and the probability of missing it the second is also $\frac{n-1}{n}$; therefore the probability of missing it twice is $\frac{(n-1)^2}{n^2}$, (Art. 14.); and hence the probability of throwing it once at least in two trials, is $1-\frac{(n-1)^2}{n^2}=\frac{n^2-(n-1)^2}{n^2}$, the same as before.

Cor. Hence it appears, that the probability of throwing one ace or more at a single throw with two dice, is $\frac{n^2-(n-1)^2}{n^2}$. For it is evidently the same whether we throw twice successively with one die, or once with two dice.

PROBLEM IX.

18. What is the probability of throwing an ace, or any proposed face of the die, in three throws, that is, either at the first, second, or third throw?

SOLUTION.—The probability required may be considered as composed of the separate probabilities of two events, viz. *first*, of the probability of throwing an ace either at the first or second throw; and, *secondly*, of the probability of missing it both at the first and second throws, and throwing it at the third.

The probability of throwing an ace in two throws has been found, by the last problem, to be $\frac{n^2-(n-1)^2}{n^2}$; and therefore (Art. 14.) the probability of missing it both throws, is $1-\frac{n^2-(n-1)^2}{n^2}=\frac{(n-1)^2}{n^2}$. Again, the probability of throwing an ace at the third throw, is $\frac{1}{n}$; and consequently the probability of missing it the first two throws, and succeeding at the third, is $\frac{1}{n}\cdot\frac{(n-1)^2}{n^2}=\frac{(n-1)^2}{n^3}$. Adding now the two probabilities, we have the probability required, expressed by

$$\frac{n^2-(n-1)^2}{n^2}+\frac{(n-1)^2}{n^3}=\frac{n^3-(n-1)^3}{n^3}.$$

In numbers the probability is $\frac{91}{216}$.

The problem may also be resolved, by finding the probability of missing an ace three times successively, which will be $\frac{n-1}{n}\cdot\frac{n-1}{n}\cdot\frac{n-1}{n}$ (Art. 16.), and this subtracted from unity, gives us $1-\frac{(n-1)^3}{n^3}=\frac{n^3-(n-1)^3}{n^3}$ for the probability of throwing an ace once or more in three throws, as before.

Cor.—Hence it appears, that the probability of throwing one ace, at least, by three dice, at one single throw, is $\frac{n^3-(n-1)^3}{n^3}$.

PROBLEM X.

19. What is the probability of throwing one ace or more in m throws, m being put for any number whatever?

SOLUTION.—Following the second mode of solution employed in the two preceding problems, we find that the probability of missing an ace m times successively, is (by Art. 16.)

$\frac{n-1}{n}\cdot\frac{n-1}{n}\cdot\frac{n-1}{n}\ldots$ (to m factors) $=\frac{(n-1)^m}{n^m}$; and this expression subtracted from unity, leaves

$$1-\frac{(n-1)^m}{n^m}=\frac{n^m-(n-1)^m}{n^m},$$

for the probability of throwing one ace, or more, in m successive throws.

Cor.—The same expression is the measure of the probability of throwing an ace, or more, with m dice at one throw.

PROBLEM XI.

20. What is the probability of throwing one ace, and no more, with a single die, in two throws?

SOLUTION.—The probability of throwing one ace, or more, at two throws, may evidently be regarded as the sum of two probabilities, viz.

1*st*, The probability of throwing one ace and no more.

2*dly*, The probability of throwing two aces.

Therefore, the probability of throwing one ace, and no more, must be measured by the difference between the probability of throwing one ace or more, and the probability of throwing two aces at two throws.

Now, the first of the two latter probabilities is $\frac{n^2-(n-1)^2}{n^2}$ (Art. 17.) and the second is $\frac{1}{n^2}$ (Art. 13.) and their difference, or the probability required, is $\frac{n^2-(n-1)^2}{n^2}-\frac{1}{n^2}=\frac{2(n-1)}{n^2}=\frac{5}{18}$.

Cor. The probability of throwing one ace, and no more, at a single throw, with two dice, is also $\frac{2(n-1)}{n^2}$.

Problem XII.

21. What is the probability of throwing one ace, and no more, in three throws?

Solution.—This probability may be considered as made up of two probabilities, viz. that of throwing an ace at the first throw, and missing an ace at each of the remaining throws; and that of missing an ace at the first throw, and throwing one ace, and no more, in the two remaining throws.

To estimate these, we must consider that the probability of throwing an ace at one throw is $\frac{1}{n}$; and that of missing an ace in two successive throws, is $\frac{(n-1)^2}{n^2}$ (Art. 17.); therefore the probability of throwing an ace at the first throw, and missing it at the second and third throws, is $\frac{1}{n}\cdot\frac{(n-1)^2}{n^2}$ (Art. 14.) $=\frac{(n-1)^2}{n^3}$.

Again, the probability of missing an ace at one throw is $\frac{n-1}{n}$; and that of throwing one ace, and no more, in two successive throws, is $\frac{2(n-1)}{n^2}$ (Art. 20.); therefore, the probability of missing an ace the first throw, and throwing an ace, and no more, in the two remaining throws, is

$$\frac{n-1}{n}\cdot\frac{2(n-1)}{n^2}\text{ (Art. 14.)}=\frac{2(n-1)^2}{n^3}.$$

Taking now the sum of these probabilities, we have

$$\frac{(n-1)^2}{n^3}+\frac{2(n-1)^2}{n^3}=\frac{3(n-1)^2}{n^3}$$

for the probability required, which, in numbers, is $\frac{3\times25}{216}=\frac{25}{72}$.

Cor. The probability of throwing one ace, and no more, at one throw, by three dice, is also $\frac{3(n-1)^2}{n^3}$.

Problem XIII.

22. What is the probability of throwing one ace, and no more, in four throws?

Solution.—This probability is the sum of the probability of throwing an ace at the first throw, and missing it in all the remaining three throws; and of the probability of missing an ace at the first throw, and throwing one, and no more, in the three remaining throws.

The probability of throwing an ace at one throw is $\frac{1}{n}$; and that of missing to throw an ace, in three successive throws, is $\frac{(n-1)^3}{n^3}$ (Art. 16.); and therefore the probability of throwing an ace at the first throw, and missing it in the three following throws, is $\frac{1}{n}\cdot\frac{(n-1)^3}{n^3}=\frac{(n-1)^3}{n^4}$.

Again, the probability of missing to throw an ace at one throw, is $\frac{n-1}{n}$, and that of throwing one ace, and no more, in three successive throws, is $\frac{3(n-1)^2}{n^3}$ (Art.21); and therefore the probability of missing an ace at the first throw, and throwing one, and no more, in the three following throws, is

$$\frac{n-1}{1}\cdot\frac{3(n-)^2}{n^3}=\frac{3(n-1)^3}{n^4}.$$

Therefore, the probability required is

$$\frac{(n-1)^3}{n^4}+\frac{3(n-1)^3}{n^4}=\frac{4(n-1)^3}{n^4}.$$

In numbers, $\frac{4\times125}{1296}=\frac{125}{324}$.

Cor. The probability of throwing one ace, and no more, with four dice, at a single throw, is also $\frac{4(n-1)^3}{n^4}$

Problem XIV.

23. What is the probability of throwing one ace, and no more, in m throws, m being any number whatever?

Solution.—We have found in the 11th, 12th, and 13th problems, that when the values of m are 2, 3, and 4, then the probabilities required are

$$\frac{2(n-1)}{n^2},\ \frac{3(n-1)^2}{n^3},\text{ and }\frac{4(n-1)^3}{n^4}$$

respectively. By reasoning as in these problems, we should find, that when $m=5$, then the probability is $\frac{5(n-1)^4}{n^5}$. Therefore, attending to the law of the formation of these expressions, it is easy to see, that, in general, the probability of throwing one ace, and no more, in m throws, is $\frac{m(n-1)^{m-1}}{n^m}$.

Cor. The same formula also expresses the probability of throwing a single ace at one throw with m dice.

Problem XV.

24. What is the probability of throwing two aces, or more, in three throws, with a single die?

Solution.—Besides the event in question, there are just other two that can possibly happen: either never an ace will come up in the three throws, or else one, and no more, will be thrown. These three events, then, making up certainty, the sum of their probabilities must be unity. Therefore, the probability required will be found, by subtracting the other two from 1.

Now, the probability of throwing never an ace in three throws is $\frac{(n-1)^3}{n^3}$ (Art. 16.); and the probability of throwing one ace, and no more, is $\frac{3(n-1)^2}{n^3}$ (Art. 23.); therefore, the probability of throwing two aces, or more, in three throws, will be

$$1-\frac{(n-1)^3}{n^3}-\frac{3(n-1)^2}{n^3}=\frac{n^3-(n-1^3)-3(n-1)^2}{n^3},$$

which, in numbers, is $\frac{216-125-3\times25}{216}=\frac{2}{27}$.

Cor. The probability of throwing two aces, or more, at one throw, with three dice, is expressed by the same formula.

Problem XVI.

25. What is the probability of throwing two aces, or more, in four throws?

Solution.—In this case we must from unity subtract $\frac{(n-1)^4}{n^4}$, the probability of throwing never an ace in three throws, and also $\frac{4(n-1)^3}{n^4}$, the probability of throwing one ace only, and the remainder,

$$1-\frac{(n-1)^4}{n^4}-\frac{4(n-1)^3}{n^4}=\frac{n^4-(n-1)^4-4(n-1)^3}{n^4},$$

is the probability required, which, in numbers, is $\frac{19}{144}$.

Cor. The same formula expresses the probability of throwing two or more aces at one throw with four dice.

Problem XVII.

26. What is the probability of throwing two aces, or more, in *m* throws, with a single die?

Solution.—By following the mode of reasoning employed in Prob. 15. and 16. and observing the law according to which the results are formed, it will appear, that *m* being any number whatever, the probability required is $\frac{n^m-(n-1)^m-m(n-1)^{m-1}}{n^m}$.

Cor. The probability of throwing two or more aces, with *m* dice, at one throw, is expressed by the same number.

Problem XVIII.

27. The probability of throwing two aces, and no more, in three throws, is required.

Solution.—The probability of throwing two aces or more, in three throws, is manifestly made up of the probability of throwing two aces and no more, and of the probability of throwing three aces; therefore, if from the first of these we subtract the third, the remainder must be the second.

The probability of throwing two aces or more, in three throws, is $\frac{n^3-(n-1)^3-3(n-1)^2}{n^3}$ (Art. 24.) and the probability of throwing three aces is $\frac{1}{n^3}$; therefore the probability of throwing two aces, and no more, in three throws, is

$$\frac{n^3-(n-1)^3-3(n-1)^2}{n^3}-\frac{1}{n^3}=\frac{3(n-1)}{n^3}.$$

which, in numbers, is $\frac{5}{72}$.

Cor. The same formula expresses the probability of throwing two aces, and no more, with three dice, at one throw.

Problem XIX.

28. The probability of throwing two aces, and no more, in four throws, is required.

Solution.—This probability may be considered as composed of the probability of bringing up an ace the first throw, and only one ace more in the three remaining throws; and of the probability of missing an ace the first throw, and throwing two aces, and no more, in the remaining throws.

The probability of throwing an ace the first throw i $\frac{1}{n}$; and that of throwing one ace, and no more, in the three following, is $\frac{3(n-1)^2}{n^3}$ (Art. 21.); therefore, the first of the two probabilities composing that required, is $\frac{1}{n}\cdot\frac{3(n-1)^2}{n^3}=\frac{3(n-1)^2}{n^4}$.

The probability of missing an ace the first throw is $\frac{n-1}{n}$; and that of throwing two aces, and no more, in the remaining throws, is $\frac{3(n-1)}{n^3}$ (Art. 27.); therefore, the second of the two probabilities is

$$\frac{(n-1)}{n}\cdot\frac{3(n-1)}{n^3}=\frac{3(n-1)^4}{n^4}.$$

Therefore the probability required is

$$\frac{3(n-1)^2}{n^4}+\frac{3(n-1)^2}{n^4}=\frac{6(n-1)^2}{n^4};$$

which, in numbers, is $\frac{25}{216}$.

Cor. The probability of throwing two aces and no more at one throw with four dice, is expressed by the same formula.

Problem XX.

29. The probability of throwing two aces, and no more, in five throws, is required.

Proceeding as in the last problem, the probability of throwing an ace the first throw, and only one more in the four remaining throws, will be, by Art. 12 and 22,

$$\frac{1}{n}\cdot\frac{4(n-1)^3}{n^4}=\frac{4(n-1)}{n^5}).$$

And the probability of missing an ace the first throw, and throwing two and no more in the remaining throws, will be, by Art. 12 and 28,

$$\frac{n-1}{n}\cdot\frac{6(n-1)^2}{n^4}=\frac{6(n-1)}{n^5}.$$

Therefore, the probability of throwing two aces and no more in five throws, is

$$\frac{4(n-1)^3}{n^5}+\frac{6(n-1)^3}{n^5}=\frac{10(n-1)^3}{n};$$

which, expressed in numbers, is $\frac{625}{3883}$.

Cor. This formula expresses also the probability of throwing two aces at one throw of five dice.

Problem XXI.

30. The probability of throwing two aces, and no more, in *m* throws, is required.

It appears from the solution of the three last problems, that when the values of *m* are 3, 4, and 5, the probabilities in question are,

$$\frac{3.2}{1.2}\,\frac{n-1}{n^3}\,\frac{4.3}{1.2}\,\frac{(n-1)^2}{n^4},\text{ and }\frac{5.(n-1^3)}{1.2\;n^5},$$

respectively. Hence, by induction, we may infer, that

m being any number whatever, the probability required is,

$$\frac{m(m-1)}{1.2}\,\frac{(n-1)^{m-2}}{n}$$

Cor. This formula also expresses the probability of throwing two aces and no more at one throw with m dice.

PROBLEM XXII.

31. The respective probabilities of throwing any number of points with two dice, are required.

SOLUTION.—It will appear upon consideration, that 2 points and 12 points can each be thrown in one way only, the first by the two aces coming up, and the second by the two sixes.

That 3 and 11 may each be thrown in two ways, the former by 1, 2 and 2, 1, and the latter by 5, 6 and 6, 5. In like manner, 4 and 10 may each come up in three ways, 5 and 9 in four ways, 6 and 8 in 5 ways, and 7 in six ways. Hence the whole number of chances is $2+4+6+8+10+6=36$:

And the probability of 2 or 12 coming up is $\frac{1}{36}$
The probability of 3 or 11 is $\frac{2}{36}=\frac{1}{18}$
The probability of 4 or 10 is $\frac{3}{36}=\frac{1}{12}$
The probability of 5 or 9 is $\frac{4}{36}=\frac{1}{9}$
The probability of 6 or 8 is $\frac{5}{36}$
And the probability of throwing 7 is $\frac{6}{36}=\frac{1}{6}$.

PROBLEM XXIII.

32. Suppose two heaps, each containing n counters, whereof a are white and b black. If a person draws a counter out of each heap, what is the probability that he draws one white counter and no more?

SOLUTION.—The probability of his drawing a black counter out of the first heap, and a white counter out of the second, is (by Art. 15.)

$$\left(1-\frac{a}{a+b}\right)\times\frac{a}{a+b}=\frac{ab}{(a+b)^2}.$$

And the probability of his drawing a white counter out of the first heap, and a black counter out of the second, is, in like manner, $\frac{ab}{(a+b)^2}$. Now the probability required is manifestly the sum of these two: Therefore its measure is $\frac{2ab}{(a+b)^2}$.

Cor. If a and b represent the number of chances for the happening and failing of an event at one trial, then every chance relating to two such events that can possibly happen in two trials, may be expressed by a fraction, whose numerator consists of one or more terms of the second power of the binomial $a+b$, and whose denominator is that power itself.

For instance, the probability in two trials of the happening of

$$\left.\begin{array}{l}\text{Two events,}\\[2ex] \text{Only one of them,}\\[2ex] \text{Neither of them,}\end{array}\right\}\text{is}\left\{\begin{array}{c}\frac{a^2}{(a+b)^2}\\[1ex] \frac{2ab}{(a+b)^2}\\[1ex] \frac{b^2}{(a+b)^2}\end{array}\right\}\begin{array}{l}\text{Prob. 6.}\\[2ex] \text{Prob. 23.}\\[2ex] \text{Prob. 7.}\end{array}$$

The sum of these three probabilities is manifestly unity, as it ought to be.

Again, the probability of both the events happening, is

$$\frac{a^2+2ab}{(a+b)^2}=\frac{(a+b)^2-b^2}{(a+b)^2};$$

and the probability that both will not happen, is

$$\frac{2ab+b^2}{(a+b)^2}=\frac{(a+b)^2-a^2}{(a+b)^2}.$$

PROBLEM XXIV.

33. Suppose three heaps, each containing a white and b black counters, and that a person draws one out of each, what probability is there that they shall be all white?

SOLUTION.—If he draws a white counter out of the first heap, the probability of which is $\frac{a}{a+b}$, then he must draw two white counters also out of the remaining heaps, the probability of which is $\frac{a^2}{(a+b)^2}$; but neither of these events will be effectual without the happening of the other, and therefore $\frac{a}{a+b}\cdot\frac{a^2}{(a+b)^2}=\frac{a^3}{(a+b)^3}$ will be the probability required.

Cor. In like manner, the probability of drawing three black counters, or of failing to draw a white one at each attempt, is $\frac{b^3}{(a+b)^3}$.

PROBLEM XXV.

34. The same things being supposed as in the last problem, what is the probability that two of the counters drawn and no more shall be white?

SOLUTION.—If the person draws a black counter the first time, the probability of which is $\frac{b}{a+b}$, then he must draw two white counters out of the remaining heaps, the probability of which is $\frac{a^2}{(a+b)^2}$; and therefore the probability of succeeding by drawing in that manner, is $\frac{b}{a+b}\cdot\frac{a^2}{(a+b)^2}=\frac{a^2b}{(a+b)^3}$.

Again, if he draws a white counter the first time, the probability of which is $\frac{a}{a+b}$, then he must draw only one white counter out of the two remaining heaps, the probability of which is $\frac{2ab}{(a+b^2)}$, (Art. 32.) therefore the probability of succeeding in this way is, $\frac{a}{a+b}\cdot\frac{2ab}{(a+b)^2}=\frac{2a^2b}{(a+b)^3}$. Now the whole probability required, is manifestly the sum of these two; therefore it is $\frac{a^2b}{(a+b)^3}+\frac{2a^2b}{(a+b)^3}=\frac{3a^2b}{(a+b)^3}$.

Cor. As the probability of drawing two white counters or more, is the sum of the probabilities investigated in the two last problems, it will be $\frac{a^3+3a^2b}{(a+b)^3}$.

PROBLEM XXVI.

35. The same things being supposed as in the two last questions, what is the probability that one white counter and no more shall be drawn?

Solution.—If he draws a white counter the first time, then at the other two trials he must draw two black ones, the probability of doing both of which is $\frac{a}{a+b}\cdot\frac{b^2}{(a+b)^2}$ $=\frac{ab^2}{(a+b)^3}$.

If he draws a black counter the first time, then at the other two trials he must draw one black and one white counter, the probability of doing which is $\frac{b}{a+b}\cdot\frac{2ab}{(a+b)^2}$ $=\frac{2ab^2}{(a+b)^3}$.

Therefore the probability required will be,

$$\frac{ab^2}{(a+b)^3}+\frac{2ab^2}{(a+b)^3}=\frac{3ab^2}{(a+b)^3}.$$

Cor. 1. The probability of drawing either one or two white counters, will be

$$\frac{3a^2b}{(a+b)^3}+\frac{3ab^2}{(a+b)^3}=\frac{3ab}{(a+b)^2}.$$

Cor. 2. The probability of drawing either one, two, or three white counters, is

$$\frac{a^3}{(a+b)^3}+\frac{3a^2b}{(a+b)^3}+\frac{3ab^2}{(a+b)^3}=\frac{(a+b)^3-b^3}{(a+b)^3}.$$

Cor. 3. The probability of drawing none, or at most but one white counter, is $\frac{3ab^2+b^3}{(a+b)^3}$.

Cor. 4. The probability of drawing none, one, or at most but two white counters, is $\frac{(a+b)^3-a^3}{(a+b)^3}$.

Cor. 5. Hence it appears, that one or more of the terms of the binomial $a+b$, raised to the third power, will be the numerators of fractions which express the probabilities of all the varieties that can possibly happen in three trials concerning events, the number of chances for the happening or failing of which are a and b respectively; and that the common denominator of all the fractions will be $(a+b)^3$

For instance, the probability in three trials of the happening of

$$\left.\begin{array}{l}\text{The three events,}\\ \\ \text{Only two of them,}\\ \\ \text{Only one of them,}\\ \\ \text{Neither of them,}\end{array}\right\}\text{is}\left\{\begin{array}{l}\frac{a^3}{(a+b)^3}\\ \frac{3a^2b}{(a+b)^3}\\ \frac{3ab^2}{(a+b)^3}\\ \frac{b^3}{(a+b)^3}\end{array}\right\}\begin{array}{l}\text{Prob. 24.}\\ \\ \text{Prob. 25.}\\ \\ \text{Prob. 26.}\\ \\ \text{Cor. to Prob. 24.}\end{array}$$

The sum of these four probabilities is evidently unity, as it ought to be.

36. Supposing a to express the number of chances for the happening of an event, and b for the chances of its failing, then it is evident from the foregoing problems, that every question that can possibly be proposed respecting the happening or failing of any number of such events in m trials, will be answered by means of one or more terms of the developement of $(a+b)^m$, as a numerator, and the whole expression, as a denominator. In particular,

1st, The probability of the happening of the m events, will be $\frac{a^m}{(a+b)^n}$,

The probability of the happening of $m-1$ of the events, will be

$$\frac{m}{1}\cdot\frac{a^{m-1}b}{(a+b)^m}.$$

The probability of the happening of $m-2$ of the events, will be

$$\frac{m(m-1)}{1\ .\ 2}\ \frac{a^{m-2}b^2}{(a+b)^m}$$

And, in general, the probability of the happening of $m-n$ of the events, will be

$$\frac{m(m-1)(m-2)\ .\ .\ .\ (m-n+1)}{1\ .\ 2\ .\ 3\ .\ .\ .\ .\ n}\ \frac{a^{m-n}b^n}{(a+b)^n};$$

the factors in the numerator being continued until their number be n; and the same in the denominator.

2d, The probability of the happening of m, $m-1$, $m-2$, or, at fewest, of but $(m-n)$, such events will be,

$$\frac{a^m+\frac{m}{1}a^{m-1}b+\frac{m(m-1)}{1\ .\ 2}a^{m-2}b^2+\frac{m.(m-1)(m-2)}{1\ .\ 2\ .\ 3}a^{m-3}b^3+\&c}{(a+b)^m}$$

the numerator of the fraction being supposed to consist of $n+1$ terms.

And the probability of the happening of at least one such event, will be

$$\frac{(a+b)^m-b^n}{(a+b)^m}.$$

3d, The probability of the happening of neither, or but one, or two, or at most, of but n, such events will be,

$$\frac{b^m+\frac{m}{1}b^{m-1}a+\frac{m(m-1)}{1\ .\ 2}b^{m-2}a^2+\frac{m(m-1)(m-2)}{1\ .\ 2\ .\ 3}b^{m-3}a^3+\&c.}{(a+b)^m}$$

the numerator of which fraction consists of $n+1$ terms.

And the probability of the happening of at most but $m-1$, such events will be,

$$\frac{(a+b)^m-a^m}{(a+b)^m}.$$

Problem XXVII.

37. Suppose a lottery, in which the number of prizes is to the number of blanks as 1 to 39; how many tickets must be purchased, that the buyer may have an equal chance for one or more prizes?

Solution.—The probability of having one prize or more in m tickets, in a lottery wherein the prizes are to the blanks as 1 to 39, is the same with that of throwing one ace or more in m throws, with a die that has $1+39=40$ faces. Therefore, putting $40=mn$, this probability will (by Prob X.) be $\frac{n^m-(n-1)}{n^m}$, which, by putting $1=a$, and $39=b$, is also $\frac{(a+b)^m-b^n}{(a+b)^m}$.

And the probability of missing, is $\frac{b^m}{(a+b)^m}$. But by hypothesis, there is to be an equal chance of the having or missing one or more prizes. Now, if the certainty of the having or missing one or more prizes be denoted by unity, then the probabilities of an equal chance, for having or missing one or more of them, will each of them be denoted by ½.

Therefore $\frac{(a+b)^m-b^n}{(a+b)^m}=\frac{b^n}{(a+b)^m}=\frac{1}{2}$;
whence $2b^m=(a+b)^m$;
which in logarithms will be,

log. $2+m$ log. $b=m$ log. $(a+b)$:

and hence, $m=\dfrac{\text{log. } 2.}{\text{log. }(a+b)-\text{log. } b}$.

Now, log. $2=.30103$, and log. $(a+b)=$log. $40=1.60206$, and log. $b=$log. $39=1.59106$; therefore $m=\dfrac{.30103}{.01100}=27.36$. By which it appears, that the number of tickets must be greater than 27.

PROBLEM XXVIII.

38. In a pack of 26 cards, 13 of which are black, and 13 red, if m cards be dealt, how many is there an equal chance of being red?

SOLUTION.—If the number of chances for the happening of the event be denoted by a, and those for its failing by b, then (by Art. 36.) $\dfrac{b^m}{(b+a)^m}$ is the probability of its not happening once in m trials. In like manner, $\dfrac{b^m+mb^{m-1}a}{(b+a)^m}$ will express the probability of its not happening twice in m trials; and

$$\frac{b^m+mb^{m-1}a+\frac{m(m-1)}{1\,.\,2}b^{m-2}a^2}{(b+a)^m}$$

expresses the probability of its not happening thrice; and so on. And because the question requires how many times the event will happen in m trials upon an equality of chance, it will follow, that when the event is to happen once, then $\dfrac{b^m}{(a+b)^m}=\frac{1}{2}$; (See Art. 37.) and when it is to happen twice, then $\dfrac{b^m+mb^{m-1}a}{(b+a)^m}=\frac{1}{2}$; and when it is to happen thrice, then

$$\frac{b^m+m\,b^{m-1}a+\frac{m(m-1)}{1\,.\,2}b^{m-2}a^2}{(b+a)^m}=\tfrac{1}{2};$$

$$\begin{aligned}\text{or } b^m &= \tfrac{1}{2}(b+a)^m;\\ b^m+m\,b^{m-1}a &= \tfrac{1}{2}(b+a)^m;\\ b^m+m\,b^{m-1}a+\frac{m(m-1)}{1\,.\,2}b^{m-2}a^2 &= \tfrac{1}{2}(b+a)^m;\\ \&\text{c.} \qquad & \qquad \&\text{c.}\end{aligned}$$

Hence it appears, that the number of terms which must be added together to make $\frac{1}{2}(b+a)$, is the answer to the question. This being premised, let $a:b::1:p$; then $\dfrac{a}{b}=\dfrac{1}{p}$; therefore, by substitution, the above expressions, will become,

$$\begin{aligned}1 &= \tfrac{1}{2}\left(1+\frac{1}{p}\right)^m\\ 1+m.\frac{1}{p} &= \tfrac{1}{2}\left(1+\frac{1}{p}\right)^m\\ 1+m.\frac{1}{p}+\frac{m(m-1)}{1\,.\,2}\frac{1}{p^2} &= \tfrac{1}{2}\left(1+\frac{1}{p}\right)^m\\ 1+m.\frac{1}{p}+\frac{m(m-1)}{1\,.\,2}\frac{1}{p^2}+\frac{m(m-1)(m-2)}{1\,.\,2\,.\,3}\frac{1}{p^3} &= \tfrac{1}{2}\left(1+\frac{1}{p}\right)^m\\ \&\text{c.} \qquad & \qquad \&\text{c.}\end{aligned}$$

Now in the present question, where $a=b$, we have $p=1$, therefore $\left(1+\dfrac{1}{p}\right)^m=(1+1)^m$; but in the developement of this quantity, the terms equally distant from either extremity are equal, therefore $\frac{1}{2}(1+1)^m$ will consist of half the terms in $(1+1)^m$; and as the whole number of terms is $m+1$, therefore the answer will be $\dfrac{m+1}{2}$.

Cor. If r represent the number of times that the proposed event is to happen, then, when there is an equality of chance for its happening or failing, $r=\dfrac{m+1}{2}$ by the problem. Therefore m, the number of trials in which it will be an equal chance, whether the event shall happen or not, will be $2r-1$.

And therefore in a lottery, in which the number of prizes is equal to the number of blanks, if it be required to know how many tickets should be bought, in order to have r or more prizes, the answer will be $2r-1$ tickets; that is, in order to have an equal chance for 1, 2, 3, 4, 5, &c. or more prizes, there should be bought 1, 3, 5, 7, 9, &c. tickets.

PROBLEM XXIX.

39. In a pack of 39 cards, consisting of 13 hearts, 13 spades, and 13 clubs, if m cards be dealt to any one, how many may he, on an equality of chance, expect to be hearts?

SOLUTION.—If a, b, and p, represent the same as in last problem, and r be the number required; then, because there are two chances for a black card to be dealt, and but one for a red card, we have $b=2$ and $a=1$, and consequently $p=2$. Therefore

$$\tfrac{1}{2}\left(1+\frac{1}{p}\right)^m=\tfrac{1}{2}(\tfrac{3}{2})^m, \text{ and in this case}$$

$1+\dfrac{m}{1}\cdot\frac{1}{2}+\dfrac{m(m-1)}{1\,.\,2}\cdot\frac{1}{4}+\dfrac{m(m-1)(m-2)}{1\,.\,2\quad 3}\frac{1}{8}+$, &c. (to r terms) $=\frac{1}{2}(\frac{3}{2})^m$.

The whole difficulty of the problem is now reduced to the finding of r, the number of terms of the series that must be added together to make $\frac{1}{2}(\frac{1}{2})^m$. Now in the last problem we found r by a direct process, but in this we cannot find it otherwise than by trials. The manner of proceeding may be as follows.

(1.) When $m=1$, then $\frac{1}{2}(\frac{3}{2})^m=0.75$;
and when $m=2$, $\qquad \frac{1}{2}(\frac{3}{2})^m=1.125$.

Now the first term of the series

$$1+\frac{m}{1}\cdot\tfrac{1}{2}+\frac{m(m-1)}{1\,.\,2}\tfrac{1}{4}+, \&\text{c.}$$

is manifestly greater than the former of these numbers, but less than the latter; hence it appears, that, when $m=1$, then 1 term is greater than $\frac{1}{2}(\frac{3}{2})^m$,
when $m=2$, then 1 term is less than $\frac{1}{2}(\frac{3}{2})^m$.

(2.) Again, if $m=4$, then $\frac{1}{2}(\frac{3}{2})^m=2.53$, &c.
and if $m=5$, $\frac{1}{2}(\frac{3}{2})^m=3.79$, &c.

(Here the values of $\frac{1}{2}(\frac{3}{2})^m$ are only found to two places of decimals, these being sufficient for our purpose; and to facilitate the operations, the calculations may be made by logarithms.) Taking now two terms of the series, we have

$$1+4\times\tfrac{1}{2}=3;\ \text{and}\ 1+5\times\tfrac{1}{2}=3.5.$$

Hence it appears, that
when $m=4$, then 2 terms are greater than $\frac{1}{2}(\frac{3}{2})^m$,
when $m=5$, 2 terms are less than $\frac{1}{2}(\frac{3}{2})^m$.

(3.) If $m=7$, then $\frac{1}{2}(\frac{3}{2})^m=8.54$, &c.
and if $m=8$, $\frac{1}{2}(\frac{3}{2})^m=12.31$, &c.

Now, taking three terms of the series, we have

$$1+7\times\tfrac{1}{2}+\frac{7\ .\ 6}{1\ .\ 2}\times\tfrac{1}{4}=9.75,\ \&c.$$

$$1+8\times\tfrac{1}{2}+\frac{8\ .\ 7}{1\ .\ 2}\times\tfrac{1}{4}=12.0,\ \&c.$$

Hence it appears that
when $m=7$, then 3 terms are greater than $\frac{1}{2}(\frac{3}{2})^m$,
when $m=8$, 3 terms are less than $\frac{1}{2}(\frac{3}{2})^m$.

(4.) By a like mode of proceeding we find, by taking four terms of the series, that
when $m=10$, then 4 terms are greater than $\frac{1}{2}(\frac{3}{2})^m$,
when $m=11$, 4 terms are less than $\frac{1}{2}(\frac{3}{2})^m$,
and in general, putting x for any number whatever, when m is

$$\left\{\begin{matrix}3x+1\\3x+2\end{matrix}\right\}\begin{matrix}\text{then } x+1 \text{ terms}\\\text{are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than }\tfrac{1}{2}(\tfrac{3}{2})^m.$$

But when the chances for the event's not happening r times in m trials (which are expressed by the series,) are less than $\frac{1}{2}$ the power; then the chances for its happening must be greater than that number. Therefore, when $m=3x+2$, there will be more than an equal chance for the event's happening $(x+1)$ times. Let us now put $r=x+1$, then $x=r-1$; and since $m=3x+2$, therefore $m=3(r-1)+2=3r-1$, and $r=\frac{m+1}{3}$. That is, if m cards be dealt, it is more than an equal chance that there should be $\frac{m+1}{3}$ hearts.

Cor. Because $m=3r-1$, therefore, if in a lottery containing two blanks to a prize, it be required to know how many tickets should be bought in order to have an equal chance for r prizes, the answer will be $3r-1$ tickets; that is, in order to have an equal chance for obtaining 1, 2, 3, 4, 5, &c. prizes, there must be bought 2, 5, 8, 11, 14, &c. tickets.

PROBLEM XXX.

40. In a pack of 52 cards, consisting of 13 of each suit, if m cards be dealt to me, how many may I, on an equality of chance, expect to be trumps?

SOLUTION.—The same symbols being retained as in the two last problems, then because there are three suits of blanks to one suit of prizes, (or trumps,) $b=3$ and $a=1$. Therefore $p=3$; and $\frac{1}{2}\left(1+\frac{1}{p}\right)^m=\frac{1}{2}(\frac{4}{3})^m$. And in this case, $1+\frac{m}{1}\cdot\frac{1}{3}+\frac{m(m-1)}{1\ .\ 2}\cdot\frac{1}{9}+$, &c. (to r terms) $=\frac{1}{2}(\frac{4}{3})^m$.

Here, as in the last problem, we must determine r by repeated trials. Accordingly, by proceeding as in that problem, we shall find that when

$$\left.\begin{array}{l}
m\left\{\begin{matrix}=2\\=3\end{matrix}\right\}\begin{matrix}\text{then one term}\\\text{of the series is}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}\\
m\left\{\begin{matrix}=6\\=7\end{matrix}\right\}\begin{matrix}\text{then 2 terms}\\\text{are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}\\
m\left\{\begin{matrix}=10\\=11\end{matrix}\right\}\begin{matrix}\text{then 3 terms}\\\text{are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}\\
m\left\{\begin{matrix}=14\\=15\end{matrix}\right\}\begin{matrix}\text{then 4 terms}\\\text{are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}
\end{array}\right\}\tfrac{1}{2}(\tfrac{4}{3})^m.$$

Therefore, in general, when

$$m=\left\{\begin{matrix}4x+2\\4x+3\end{matrix}\right\}\begin{matrix}\text{then } x+1\\\text{terms are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than }\tfrac{1}{2}(\tfrac{4}{3})^m.$$

Therefore, when $m=4x+3$, there will be something more than an equal chance of the event's happening $n+1$ times. Now, since $m=4x+3$, therefore $x=\frac{m-3}{4}$. And since $r=x+1$, therefore $x=r-1$; hence $r-1=\frac{m-3}{4}$, and $r=\frac{m+1}{4}$. That is, if m cards are dealt, it will be more than an equal chance that there will be $\frac{m+1}{4}$ trumps. Therefore, in the game of whist, where 13 cards are dealt, there is more than an equal chance for any particular person having $\frac{13+1}{4}=\frac{14}{4}$ trumps. And since this is more than an equal chance, if any player have but three trumps, or less, he may justly conclude that his partner has four trumps, or more.

Cor. Since $r-1=\frac{m-3}{4}$, therefore $m=4r-1$; Hence it follows, that in a lottery where there are three blanks to a prize, if it be required to know how many tickets should be bought in order to have r prizes, the answer will be $4r-1$ tickets; thus, in order to have 1, 2, 3, 4, 5, &c. prizes, there must be bought 3, 7, 11, 15, 19, &c. tickets.

PROBLEM XXXI.

41. In a lottery which has four blanks to a prize, if a person purchase m tickets, how many prizes may he expect on an equality of chance?

SOLUTION.—The same symbols being retained as before, we have, in this case, $b=4$ and $a=1$: and hence $p=4$, and $\frac{1}{2}\left(1+\frac{1}{p}\right)^m=\frac{1}{2}(\frac{5}{4})^m$. Therefore in this case we must find r, the number of terms of the series

$$1+\frac{m}{1}\cdot\tfrac{1}{4}+\frac{m(m-1)}{1\ .\ 2}\tfrac{1}{16}+\frac{m(m-1)(m-2)}{1\ .\ 2\ .\ 3}\tfrac{1}{64}+\&c.$$

the sum of which is $\frac{1}{2}(\frac{5}{4})^m$.

By proceeding as in Prob. XXIX. it will be found by trials, that when

$$\left.\begin{array}{l}
m\left\{\begin{matrix}=3\\=4\end{matrix}\right\}\begin{matrix}\text{then one term}\\\text{of the series is}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}\\
m\left\{\begin{matrix}=8\\=9\end{matrix}\right\}\begin{matrix}\text{then 2 terms}\\\text{are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}\\
m\left\{\begin{matrix}=13\\=14\end{matrix}\right\}\begin{matrix}\text{then 3 terms}\\\text{are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}\\
m\left\{\begin{matrix}=18\\=19\end{matrix}\right\}\begin{matrix}\text{then 4 terms}\\\text{are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than}
\end{array}\right\}\tfrac{1}{2}(\tfrac{5}{4})^m$$

Therefore, in general, when

$$m=\left\{\begin{matrix}5x+3\\5x+4\end{matrix}\right\}\begin{matrix}\text{then } x+1\\\text{terms are}\end{matrix}\left\{\begin{matrix}\text{greater}\\\text{less}\end{matrix}\right\}\text{than }\tfrac{1}{2}(\tfrac{5}{4})^m.$$

Therefore, when $m=5x+4$, there will be something more than an equal chance of the required effect's happening $x+1$ times.

And since $m=5x+4$, therefore $x=\frac{m-4}{5}$; also since $r=x+1$, therefore $x=r-1$, hence $r-1=\frac{m-4}{5}$, and $r=\frac{m+1}{5}$. That is, $\frac{m+1}{5}$ prizes may, on an equality of chance, be expected in m tickets.

Cor. Since $r-1=\frac{m-4}{5}$, therefore $m=5r-1$. Hence it appears, that in such a lottery, in order to have an erual chance for r prizes, there must be purchased $5r-1$ tickets; that is, 1, 2, 3, 4, 5, &c. prizes require 4, 9, 14, 19, 24, &c. tickets.

PROBLEM XXXII.

42. If a person playing with a single die determines to cast it m times, how many times out of that number may he, on an equality of chance, undertake to cast an ace. Or, (which is the same thing,) if he cast m dice at once, how many of them may he, on an equality of chance, expect to be aces?

SOLUTION.—Retaining the same symbols, in this case, $b=5$, $a=2$, $p=5$, and $\frac{1}{2}\left(1+\frac{1}{p}\right)^m=\frac{1}{2}\left(\frac{6}{5}\right)^m$.

We must now find r the number of terms of the series

$$1+\frac{m}{1}\frac{1}{5}+\frac{m(m-1)}{1\,.\,2}\frac{1}{25}+\frac{m(m-1)(m-2)}{1\,.\,2\,.\,3}\frac{1}{125}+\&c.$$

which are equivalent to $\frac{1}{2}\left(\frac{6}{5}\right)^m$.

By proceeding as in the foregoing problems, it will appear, that when

$$\left.\begin{array}{l} m\begin{Bmatrix}=3\\=4\end{Bmatrix}\begin{array}{l}\text{then one term}\\\text{of the series is}\end{array}\begin{Bmatrix}\text{greater}\\\text{less}\end{Bmatrix}\text{than}\\ m\begin{Bmatrix}=9\\=10\end{Bmatrix}\begin{array}{l}\text{then 2 terms}\\\text{are}\end{array}\begin{Bmatrix}\text{greater}\\\text{less}\end{Bmatrix}\text{than}\\ m\begin{Bmatrix}=15\\=16\end{Bmatrix}\begin{array}{l}\text{then 3 terms}\\\text{are}\end{array}\begin{Bmatrix}\text{greater}\\\text{less}\end{Bmatrix}\text{than}\\ m\begin{Bmatrix}=21\\=22\end{Bmatrix}\begin{array}{l}\text{then 4 terms}\\\text{are}\end{array}\begin{Bmatrix}\text{greater}\\\text{less}\end{Bmatrix}\text{than}\end{array}\right\}\tfrac{1}{2}\left(\tfrac{6}{5}\right)^m.$$

So that, in general, when

$$m=\begin{Bmatrix}6x+3\\6x+4\end{Bmatrix}\begin{array}{l}\text{then } x+1\\\text{terms are}\end{array}\begin{Bmatrix}\text{greater}\\\text{less}\end{Bmatrix}\text{than }\tfrac{1}{2}\left(\tfrac{6}{5}\right)^m.$$

Therefore, when $m=6x+4$, there will be something more than an equal chance of the required effect's happening $x+1$ times. And since $m=6x+4$, therefore $x=\frac{m-4}{6}$. Also, since $r=x+1$, therefore $x=r-1$; hence $r-1=\frac{m-4}{6}$, and $r=\frac{m+2}{6}$.

Hence it appears, that in a lottery in which there are five blanks to one prize, if m tickets are bought, then on an equality of chance, $\frac{m+2}{6}$ prizes may be expected.

Cor. Since $r-1=\frac{m-4}{6}$, therefore $m=6r-2$. Whence it appears, that if it be required to know how many tickets should be purchased in such a lottery, in order, on an equality of chance, to expect r prizes; the answer will be $6r-2$. Therefore, in order to have 1, 2, 3, 4, 5, &c. prizes, there should be purchased 4, 10, 16, 22, 28, &c. tickets.

PROBLEM XXXIII.

43. In a lottery where the number of blanks is to the number of prizes as b to a; how many tickets must be purchased to procure an equal chance for p or more prizes?

SOLUTION.—From a careful observation of the corollaries to the five preceding problems, it will appear, that the series which in each expresses the number of tickets that ought to be purchased, in order to procure an equality of chance for the having 1, 2, 3, 4, 5, &c. prizes, do severally differ by 2, 3, 4, 5, 6, which, in each separate question, is the number of blanks $+1$, or (since there is supposed only one prize to a certain number of blanks) the number of chances which one ticket has of being either a blank or a prize. Thus in corollary to Prob.

28	Wherein the lottery was supposed to have	1	blanks to one prize; the number of tickets necessary to the expectation of 1, 2, 3, 4, 5, &c. prizes, was	1, 3, 5, 7, 9, &c.	which numbers differ by	2	the number of chances which one ticket has of being either blank or prize.
29		2		2, 5, 8, 11, 14, &c.		3	
30		3		3, 7, 11, 15, 19, &c.		4	
31		4		4, 9, 14, 19, 24, &c.		5	
32		5		4, 10, 16, 22, 28, &c.		6	

Therefore we may conclude, that the same thing will happen in all succeeding questions of this sort; and consequently, that if the first term of the series can be obtained, then all the rest will be found by the addition of $(a+b)$.

Now the first term of this series may be found by Prob. XXVII. where the number of tickets which must be purchased, that the buyer may have an equal chance to have one prize, is $\frac{\log.\ 2.}{\log.\ (a+b)-\log.\ b}$. Therefore this quotient, if an integer, or the next greater integer if a fraction, will be the first term of the series. And if we call this quotient q, and put $a+b=s$, then, in order to have an equal chance for 1, 2, 3, 4, 5 prizes, we must purchase q, $q+s$, $q+2s$, $q+3s$, $q+4s$, &c. tickets. Or universally, in order to have an equal chance for p prizes, we must purchase $q+(p-1)s$ tickets.

For the application of the doctrine of chances to annuities, see ANNUITIES.

List of writers and works on the subject of chances.

Pascal and *Fermat*.

Jac. Bernoulli *Ars Conjectandi Opus Posthumum.*

Lettre à une Amy, sur les parties du Jeu de paume; subjoined to the *Ars Conjectandi.*

De ratiociniis in Ludo Alcæ, Auctore Christ. Hugenio.

Essai d'analyse sur les jeux de hasard, par Monmort

De Moivre's *Doctrine of Chances.*

Miscellanea Analytica, by the same author.

Specimina artis conjectandis ad questiones juris applicatæ, by Nicolas Bernoulli, in the *Leipsic Acts*, 1711.

Simpson *On the Nature and Laws of Chance.*

Sur l'usage du principe de la raison suffisante dans le *calcul des probabilités* par Beguelin. *Memoires de Berlin*, 1767.

Opuscules Mathematiques ; par D'Alembert.

Essai sur l'application de l'analyse a la probabilité des decisions à la pluralité des voix, par Condorcet.

Dodson's *Mathematical Repository*.

Emerson *On the Laws of Chance*, in his *Miscellanies*. (ξ)

CHANTRY, or Chauntry, (*Cantaria*,) a small chapel or church, or private altar in a cathedral or other public place of worship, with an endowment for one or more priests, on condition that they should *sing mass*, and perform other divine services for the soul of the founder, or of such also of his descendants or other relations as he may have provided for by the grant. These endowments, however, as originating in the Romish superstition, were effectually abolished by Stat. 1 Ed. VI, c. 14, which declares all entry into the lands, or other revenues, in terms of the foundation, unlawful, and confers the property upon the king, under certain exceptions in favour of universities and other public seminaries. From Dugdale's history of St Paul's, it appears that not fewer than forty-seven chantries belonged to that church. (J. B.)

CHAPEL, (*Capella*,) a place of divine worship, and of which there are commonly reckoned four different sorts. 1st, *Chapels of ease*, which are provided for the *ease* or convenience of the parishioners, where the parish is of great extent. In England, these chapels are served by inferior curates provided at the charge of the rector, or other parish priest, and they are accordingly removable at his pleasure; although in some instances chapels of ease have right, by custom, to a distinct minister, and to sacraments and other church privileges, and are endowed with tithes. In Scotland, the minister is, for the most part, of the parishioners own appointment, and is maintained by a salary arising from the seat rents. He has right to sacraments, &c. but has no voice in any of the church courts. 2d, *Free chapels*, which have been endowed by the sovereign, or by pious and charitable persons, and are therefore called free, being no charge upon the parish, or rather perhaps because they are exempt from all ordinary jurisdiction. 3d, *Chapels belonging to universities*, or to particular *colleges* in universities, which are consecrated, and have right to sacraments, &c. but are not liable to any visitations but that of the founder. 4th, *Private* or *domestic chapels*, which are built and maintained by noble and wealthy families for private worship, in or near their own houses. These need not be consecrated, and may be erected without leave of any superior, nor are they subject to ordinary jurisdiction.

Besides these, there are what are called *parochial chapels*; but these differ from parish churches only in name, and seem to be so denominated only because they are generally smaller than most churches, and the inhabitants within the district few. *Burying places*, also, which have been erected by great families adjoining to, or within a cathedral or other church, are sometimes denominated *chapels*. (J. B.)

CHAPLAIN, (*Capellanus*,) one attendant on the household of the king, or other honourable person, to say divine service, which is commonly performed in the family private chapel. Each individual of the royal family may retain any number of chaplains; but by stat. 21 Hen. VIII, c. 13, an archbishop is limited to *eight*; a duke or a bishop *six*; marquis or earl *five*; viscount *four*; baron, knight of the garter, or lord chancellor, *three*; a duchess, marchioness, countess, baroness, (being widows,) the treasurer and comptroller of the king's house, the king's secretary, dean of the chapel, almoner, and master of the rolls, each of them *two*; the chief justice of the king's bench, and warden of the cinque ports, *one*. And by stat. 25 Hen. VIII. c. 16, every judge of the king's bench and common pleas, the chancellor and chief baron of the exchequer, and the king's attorney and solicitor general, may each of them have *one* chaplain attendant on his person. And by 33 Hen. VIII. c. 28, the groom of the stole, treasurer of the king's chamber, and chancellor of the duchy of Lancaster, may also retain each *one* chaplain. Under the 21 of Henry, the statute first quoted, the chaplains thereby allowed may purchase a licence or dispensation, and take two benefices with cure of souls; but those allowed by the two last can have one benefice only, on which they may be non-resident.

In England, the king has commonly forty-eight chaplains in appointment, four for each month of the year, whose duty is to preach in the chapels-royal, and read the service to the family. They have no salary, being commonly well provided otherwise. In Scotland he has six, who have each a salary of 50*l.* and three of these have besides the deanery of the chapel-royal divided among them, which extends their emolument to upwards of 100*l.* each. The sum of their duty is to say prayers at the election of the sixteen representative peers for Scotland. (J. B.)

CHARA. See Astronomy, p. 704.

CHARA, a genus of plants of the class Monœcia, and order Monandria. See Botany, p. 313.

CHARACTER, (from the Greek χαράττω, *I cut, engrave, or indent*,) in the literal and radical sense denotes *any thing cut or engraved*; hence any kind of peculiar mark cut, drawn, or any way set or impressed upon a substance capable of receiving and retaining it. From this radical sense the word is now applied to denote, 1st, A mark or figure drawn or formed, for the purpose of denoting or suggesting some particular object or idea otherwise than by direct representation. 2d, The peculiar and distinguishing properties belonging to an individual, the marks, as it were, by which that individual is distinguished from all others. 3d, By a natural transition from the last, the persons or agents exhibited in narrative or poetical composition, such agents being necessarily marked by peculiar and distinctive qualities.

I. A mark or figure drawn or formed, for the purpose of denoting or suggesting some particular object or idea otherwise than by direct representation.

The invention and application of marks to denote and suggest objects of which they are not the direct pictures, has its rise from the well known principle of association; and the same necessity of mutual communication, which led originally to the formation of oral language, could not fail, at a very early period, to give rise also to the invention and use of visible figures, for fixing and exhibiting to the eye what oral language was either insufficient to convey, or incapable of permanently retaining. In the formation of such signs, recourse would at first be had to direct and immediate representation, the mark would probably be nothing more than a picture, more or less perfect, of the object to be denoted. Alterations, however, would soon arise; convenience would introduce abbreviations even in picture marks exhibiting objects capable of direct delineation; and experience would as quickly indicate an immense multitude of objects necessary to be denoted, but totally unsusceptible of immediate ocular delineation. For the denoting of these, therefore, arbitrary or conventional marks could only be employed; these marks might be formed at first from some real or supposed analogy to the objects of sight, but afterwards might gradually assume peculiar and distinctive forms, suggesting by association the objects intended to be pointed out.* In this manner, it is not improbable, most of those marks or figures originated, which are properly known by the term CHARACTERS, which are, in fact, conventional signs, more or less general in their application, invented and employed for denoting and suggesting such objects of thought as it is found either impracticable or inconvenient to exhibit by picture or immediate delineation.

In every branch of knowledge, therefore, CHARACTERS may be introduced and employed. To multiply them, however, too much, would impede instead of facilitating the means of mutual communication: their number and varieties will be determined by the necessity or convenience which may render this aid to oral language desirable. When a series of characters have been invented and brought into use, susceptible of very general application, the necessity of other classes of more limited use is in a great measure superseded. When characters adapted to express all the words of a language have been formed, it will not often be necessary to devise or retain separate sets for denoting the terms of each particular science. Experience, however, has shewn, that even where general characters are in use, there are particular subjects, in which vast advantage will be found from employing appropriate and distinctive characters; convenience or habit may likewise, in certain branches of knowledge, occasionally bring into, or keep in use, peculiar symbols, which, though not absolutely necessary, may be useful, as furnishing means of easy and expeditious expression. Different species of characters will thus arise, none of them without their appropriate use. It is, however, always to be wished, that, in every case, the characters employed be distinct and clear in their form, easily recognised and understood, and never so extended or multiplied as to fatigue and encumber, instead of aiding the memory and understanding.

It would be an almost endless task to go through all the various kinds and classes of characters, invented and employed for denoting the objects of thought; it will be sufficient to take notice of such as, from their intrinsic importance and general use, particularly merit attention.

The species of characters most commonly in use, may be arranged under the heads of Literal Characters, Numeral Characters, and Symbolical Characters.

1. Literal Characters, including all such as are used for denoting language in general.

These may be distinguished into *alphabetic characters*, used for denoting the elemental sounds of language, and, by combination, expressing all the varieties of words; and *real characters*, employed or intended as the signs of things or ideas independent of sounds. For a full account of both, in regard to their nature, origin and use, see Alphabet. Of these two kinds of character, alphabetic characters are by far most generally in use. The adoption of the real or ideal characters appears to be confined to the Chinese, or the nations immediately connected with China. Judging no less from reason than experience, we are fully warranted in asserting the immense superiority of alphabetic writing.

The form of alphabetic characters differs much among different people. The Hebrew, or some of its kindred dialects, may probably claim the highest antiquity; from its cognate the Phœnician, arose the old Pelasgic and Grecian alphabets; from these was formed the Latin character, in common use through the greater part of Europe to the present day. The Syriac, Chaldee, and Arabic character, were evidently formed from the ancient Hebrew, which was in use before the Babylonish captivity, and is still found on some medals, commonly termed Samaritan. The square Hebrew at present in use, was only introduced among the Jews subsequent to the captivity. The Greek character, in more ancient times, consisted entirely of majuscule letters, or capitals; and it is this mode of writing alone which is found in all the ancient inscriptions and medals, as well as in those manuscripts that are not of modern date. The smaller Greek character is comparatively a recent invention. Medalists observe, that the Greek character preserved its uniformity down to the time of Gallienus, after which it appears weaker and rounder. From the time of Constantine to Michael, the Latin character chiefly prevails; the Greek characters then recommence, though altered, in some respects like the language, by the mixture of Latin. The Latin medals preserved their character, as well as language, till the translation of the empire to Constantinople. Before the time of Decius, the Latin character began to lose its roundness and beauty; and after the time of Justin gradually degenerated into the Gothic. The modern European character, formed from the Latin, is too well known to require any particular notice. It is used in most parts of Europe. The Germans, however, have a peculiar character, compounded of the Gothic and Latin; but of late, even among them, the Roman character used in the other European countries has been gaining ground, and may probably in time supersede the other. The modern Greeks still adhere to the proper Greek character; and the Russians make use of a character of their own, formed in part from the Greek capitals, though in several of the letters considerably altered.† The Oriental alphabets are numerous, and their characters extremely diversified. The figures of the letters are frequently complicated and inelegant, and may, in general, be pronounced inferior, both for beauty and convenience, to the ancient Greek or the modern European character. Specimens of different kinds of character, as well ancient as modern, are given under the article already referred to.

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† The Russian alphabet is principally, and with little variation, taken from the Slavonic; but several of the characters of both alphabets are similar to the Greek and Latin. The composition of the Russian alphabet is as follows: Of the vowels, five are formed like or nearly like Greek or Roman characters, they are A, E, O, I, and Y, pronounced *oo*. They have also the Greek H, somewhat varied in its form by a diagonal instead of a horizontal line. The remainder are purely Slavonic. Among the

* The following well known story affords a good example of the natural rise and progress of such character marks. A tavern-keeper in Hungary unable to write, kept account of the sums due to him by strokes chalked on his door; to each series of strokes was annexed a figure to denote the customer to whom they applied. The soldier was represented by the figure of a musket, the carpenter by a saw, the smith by a hammer. In a short time for convenience, the musket was reduced to a straight line, the saw to a zig-zag line, the hammer to a cross; and thus began to be formed a set of characters gradually receding from the original figure. The resemblance at last might be entirely lost sight of, and the figures become mere arbitrary marks. Such probably was the rise of a great part of the Chinese characters.

The REAL CHARACTER is constructed on different principles from the alphabetic. The object of the latter is to express, by figures, the *fundamental sounds* of speech, separately, or in their various combinations. The object of the former, or real character, is to express only *things* or *ideas*, without regard to the particular sounds by which these are communicated in speech, so that persons, whose oral language is totally dissimilar, may, by the use of this species of character, at once understand and communicate with each other, though their *speech* may be mutually unintelligible. Such is actually the case with the written characters of the Chinese and Japanese; and such, though in a more limited degree, is the case in regard to the numeral characters of the inhabitants of modern Europe. For an account of the REAL CHARACTER, see the above mentioned article ALPHABET.

The only people among whom the real character appears to have come into actual use, are the Chinese, and those immediately connected with them; for the Egyptian hieroglyphics cannot be said to belong to this class. Judging from the progress of knowledge and state of society among these nations where the real character prevails, we should not be inclined to estimate very highly the benefits of this mode of communication. Yet some ingenious philosophers have attempted to devise, and bring into use, such a mode of writing. One of the most celebrated of these attempts is that of Bishop Wilkins, in his *Essay towards the formation of a real Character and Philosophical Language*. M. Leibnitz projected something of a similar nature, under the title of what he termed an *Alphabet of Human Thoughts*, but he never completed his scheme. M. Lodovic, in the *Philosophical Transactions*, proposed a plan of an *universal alphabet or character*; and in the *Journal Literaire* for the year 1720, the formation of an universal character is suggested, by the application of the Arabic numerals in various combinations. None of these schemes, however ingenious in structure, have been found applicable to purposes of practical utility. It is not difficult to devise a new character, but to bring it into use will probably always be found impracticable; and even if it were practicable, the advantage of it is extremely questionable.

2. NUMERAL CHARACTERS, or marks used for notation of numbers.

Next in use and importance to alphabetic characters, is that class of characters known by the name of *numerals*. These are unquestionably one species of real character, and probably the only one that could with advantage be adopted into general use. For an account of the origin and progress of numeral notation, see ARITHMETIC.

The idea of number suggests itself, by abstracting from objects every circumstance except their individuality. It is probable, that, when men first began the practice of numeration, they would proceed by taking some of the objects immediately before their eyes, and intimating, that those of which they were speaking were equal to them in number. As the objects most universally present to all men are the fingers, these would of course be the earliest measure of numbers; and numeration would thus be formed into a scale either of *fives* or *tens*. The former have sometimes been found, but the latter, or the decuple progression, is nearly universal. The process of numeration being commenced, it would be necessary, in order to carry it on, that some marks should be found to denote the numbers in their progress. It is probable that the earliest, as it was the simplest species of mark, would be a mere notch upon a board, the repetition of which would designate the number of objects to be counted. It is evident, that, in this mode of notation, the eye can easily and readily recognise the different numbers only a very little way. One, two, three, and even four, can be easily distinguished, as we find in the dials of church clocks, but farther than this the power of distinction becomes difficult, and is at last entirely lost. After four strokes are put down, therefore, it is necessary to make some alteration in the mark, to shew where a new series is to commence. This could most easily be done, by making a diagonal stroke through the four preceding. A progression would then take place by a new series of strokes, and, at the end of the second five, a diagonal in the opposite direction would point out the second termination. Here we have the evident origin of the Roman mode of notation. The first diagonal produced the V, the mark of *five*, the second the X, the mark of *ten*. After *ten* the same notation would go on to a *second ten*, which would be denoted by a double X, a third by a triple, and a fourth by a quadruple X. The same difficulty of distinguishing by the eye beyond four similar figures, would make it necessary, at the *fifth ten*, to introduce another change. This was done by a horizontal line at the bottom, making a figure similar to L. At the tenth ten another addition became necessary, which produced the figure ⊏, afterwards modified into a C for *one hundred*. By a similar process, the fifth hundred was marked by a new line □, which soon passed into a D, the mark for 500. The tenth hundred became double ⊏□, easily changing into an M for 1000. This mode of notation of numbers, which is the rudest and most simple, was retained to the last among the Romans, improved in a small degree

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consonants, they have B (pronounced V) F, K, M, Π, C, T, Φ, and X, sounded guttural. They have also the Greek Δ, Λ and P, but a little varied in form. They have H, which stands for N. In their prayer books, they frequently make use of the Greek Θ, which they call *pheeta*, and pronounce like the Φ, and sometimes of Ξ, which is sounded as in the Greek. The form of these two last letters is also somewhat varied: the remainder of their alphabet is wholly Slavonic. They have no aspirate, and when the letter H occurs in foreign names of men or places, they express it by Γ, *durum*.

The Poles, whose language is derived from the same source with the Russian, and is, like it, a dialect of the Slavonic mother-tongue, make use altogether of the Roman alphabet; but as the Slavonic languages have several sounds which do not exist in those of Teutonic and Latin derivation, they have recourse to accents and commas, placed sometimes above, sometimes below their letters, and to little bars across some of them, by means of which, they are able to express in Roman characters, all the sounds of the Slavonic idioms, which they could not otherwise do. DUPONCEAU.

by certain abbreviations; and it is radically the same as at this day is used by the Chinese; only as the Chinese mode of writing is in perpendicular, not horizontal, lines, the position of their numeral marks corresponds to that peculiarity in their mode of writing.

The inconvenience of this mode of notation, where the objects of numeration were much extended, would soon be felt, and some more convenient way of reckoning would be sought. Among those people where the use of letters had been introduced, a ready substitute was found in the alphabetic characters; and these we find actually so employed at a very early period among the Hebrews, and their immediate neighbours, from whom the invention passed to the Greeks. The Hebrew alphabet had only 22 letters, but several of these having two forms, it became easy to construct three series of numeral marks, nine in each, and, by using these according to the decuple progression, to denote *units*, *tens*, and *hundreds*, numeral notation as far as a thousand was made easy. *Thousands* were expressed, by using the same marks with an accent annexed. This mode of numeral notation was exactly copied by the Greeks, who, to complete their three series of nines, inserted three additional marks, called the *episemon*, the *koppa*, and the *sanpi*. *Thousands* they expressed also by the same characters, with an accent below.[*]

In this manner an extensive numeral notation was obtained; but it had the great inconvenience, that the large numbers, being expressed by one entire mark, could not readily, in performing arithmetical operations, be broken into smaller constituent parts. These operations, therefore, became cumbersome and difficult in a high degree. The complete remedy for this inconvenience was found, by that immense improvement in the mode of numeral notation, of confining the whole numeral characters to one series only, and giving this series successively the power of the second, the third, or any higher series, by means of *position* alone; the same characters in the first row denoting *units*, in the second *tens*, in the third *hundreds*, and so forward as far as numeral expression is required.

This may justly be set down as the perfection of numeral notation, and gives modern arithmetic the most decided superiority over the ancient. It is commonly supposed to have been derived to us from the Arabs, who are thought to have learned it from the Indians. Some doubts, however, have been lately started upon this point; and Ance de Villoison, in the 2d volume of his *Anecdota Græca*, quotes an Italian author, who maintains, that our modern numeral characters were derived from the Greeks, having been used by them in the times of the emperors for expressing weights and measures, and afterwards extended to express any kind of number. It is not perhaps easy to determine the point, nor is it of much importance; but it is curious to observe, that something of this mode of notation appears in the Hebrew numerals; for though with them three series of characters were used for *units*, *tens* and *hundreds*, and *thousands* were denoted by applying to these respectively an accentual mark, yet frequently, too, when both thousands and hundreds were to be put down together, the *thousands* were signified, by merely placing the proper numeral without an accent, before the mark for the *hundreds*,—an approach undoubtedly to the modern mode of notation, though it does not appear to have ever led to farther improvements.

As the best illustration of this subject, specimens of different kinds of numeral characters are given in Plate XL. See also NUMBER and NUMERAL NOTATION.

3. SYMBOLICAL CHARACTERS, or characters intended to express a particular object or idea by means of a mark bearing some supposed or imaginary analogy to the thing represented.

Symbolical characters differ from the two former classes of characters in this, that in the former, the signification of the mark is purely arbitrary; in the symbolical, it is connected with the object by some real or supposed resemblance, sometimes in appearance, but more commonly in properties, operations, or effects. Symbolical characters probably had their rise from picture writing, and were at first mere abbreviations, but afterwards became specific marks, formed by peculiar though arbitrary rules. Of this class of characters there are numerous kinds, such as hieroglyphics, symbols, armorial-bearings, and other heraldric signs; to which may be added, musical notes, scientific abbreviations, &c. For the account of each, see under the proper heads, HIEROGLYPHICS, SYMBOLS, HERALDRY, MUSIC, ALGEBRA, &c.

II. The peculiar and distinguishing properties belonging to an individual. This application of the term arises from these peculiar properties being regarded as the marks by which different individuals of the same species were distinguished and recognised. It is seldom, if ever, applied to bodily powers; and even in mental qualities, refers generally, though not universally, rather to moral than intellectual endowments. See MORAL PHILOSOPHY.

III. The persons or agents exhibited in poetical or narrative composition. The distinctive properties of individuals, when in any way remarkable, forming, as it were, the marks by which they are recognized, these are frequently regarded as constituting the individual himself, especially when, by the influence or operation of such peculiar qualities, important events are produced upon the situation and conduct of other men. From this species of personification, the denomination of *characters* has been introduced, as denoting the individuals by whom the actions or events, which form the subject of composition, either poetical or narrative, are carried on. In regard to what belongs to such characters, and in what manner their introduction, developement, and operations, are to be regulated, see under the heads of EPIC POETRY, TRAGEDY, COMEDY, NOVEL WRITING, HISTORY, BIOGRAPHY, &c.

Besides the foregoing different applications of the form character, there are other subordinate ones; but as they all relate immediately, or remotely, to those already considered, they require no particular notice. (δ)

CHARACTER OF KEYS, in Music. Most of those writers who have brought forward *irregular systems* of temperament, or such wherein an invariable law is not observed (as far as the scale or number of notes in the octave will admit) in the temperament of the different concords, as in *regular douzeaves* for instance, in the case where eleven of the fifths are tuned equal, have insisted much on the advantages of what they call the peculiar character of certain keys, arising from their varied and often very considerable degrees of imperfection, in the principal concords of such keys. Earl Stanhope was one of those who insisted on the advantage of the great contrast of the harmony in some of the keys in his temperament, when compared with others. This gave rise to a controversy on the subject in the *Monthly Magazine*, vol. 22 and 23, in which the very able and much to be lamented Dr Callcott took a part. From all, however, that we have read or heard, we are disposed entirely to disregard the characters of keys derived from their imperfections; and to contend, that nothing seems wanting to heighten the pleasure of hearing modulation skilfully conducted, on regularly tempered scales, and where the different keys are *exactly alike tempered*, as on D. Loeschman's patent instruments with 24 strings or pipes in each octave, or by able singers or violin players, who use *no tempered harmonics* whatever; and the same has lately been more fully confirmed, by often hearing the Rev. Henry Liston's patent organ, where every harmony is given absolutely *perfect*, and yet nothing seemed wanting in the effects of its modulations, or of the pieces performed upon it in different keys. (ρ)

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[*] The Greeks had two other modes of numeral notation; one by using the letters for numeral marks just according to their place in the alphabet; the other by the adoption of the following marks: I to denote *one*, Π *five*, Δ *ten*, H *one hundred*, X a *thousand*, M *ten thousond*. It is commonly supposed that these marks came to be so used, as being the initial letters of the words denoting the respective numbers. May they not rather have been the remains of a mode of notation similar to the Roman, in which they originally served as the distinguishing marks of the respective series, and, for convenience, were retained, after a better notation was introduced?

CHARACTERISTIC NOTES, in music, are the leading note, and the subdominant. Their uses in pointing out the *key* of a piece of music, where the proper number of sharps or flats happens not to have been affixed to the beginning of the piece, or supplied afterwards at the beginning of staves where modulation has taken place, are fully treated of by Dr Callcott, in his *Musical Grammar*, art. 278, &c. (ρ)

CHARCAS. See BUENOS AYRES.

CHARCOAL. This is a well known black substance, which possesses many singular chemical properties, the details of which will be given under the article CHEMISTRY. In the present article we shall confine ourselves to the modes of preparation employed in Britain and in France, and to its economical uses.

Charcoal which is employed as fuel, is obtained generally from wood of different kinds; the most dense and hard being preferred. The white and resinous woods are commonly rejected. Large timber is seldom employed for this purpose, both because it is too expensive, and because it does not yield charcoal equal in quality to that procured from coppice wood. Pieces of three or four inches thick must be cloven into four pieces.

It is an object of some moment to ascertain the most productive wood in the preparation of charcoal; and although accurate results are not to be expected on the great scale, yet experiments made by Mr Mushet afford very good general proportions, which may be the rule by which the products may be estimated.

The following Table exhibits very satisfactorily the results of these experiments.

				Colour.
100 parts of	Lignum Vitæ afforded	26.8	charcoal,	greyish.
———	Mahogany	25.4	———	brown.
———	Laburnum, ...	24.5	———	velvet black
———	Chesnut	23.2	———	glossy black.
———	Oak	22.6	———	black
———	American Black Beech	21.4	———	fine black.
———	Holly	19.9	———	dull black.
———	Sycamore	19.7	———	fine black.
———	Walnut	20.6	———	dull black
———	Beech	19.9	———	dull black
———	American Maple . .	19.9	———	dull black.
———	Norway Pine, . . .	19.2	———	shining black
———	Elm	19.5	———	fine black.
———	Sallow	18.4	———	velvet black.
———	Ash	17.9	———	shining black
———	Birch	17.4	———	velvet black.
———	Scottish Pine . . .	16.4	———	brownish.

In Scotland very large quantities of charcoal are prepared for the iron works, in the following way:—A platform, having a diameter of from twenty to thirty feet, is formed on the ground, by laying strata of earth upon it, and giving it a slightly convex surface. On the centre of this circular area, a circle of sticks are so placed as to cross each other a little below the top, and thus to form a cavity resembling an inverted cone, around which successive concentric layers of truncheons, having a diameter of from one to ten inches, are placed; care being taken, that the truncheons in the same circle are of the same size, and as few interstices as possible left. The exterior circle is composed entirely of brushwood. When the platform is nearly covered, a coating of turf is laid on the pile, the grassy side being next to the wood; dry earth is then heaped up around the lower part, and well rammed down, so as to exclude all air. The pile is then lighted, by placing a few inflamed chips of wood in the interior cavity; and when these are consumed, others are added during the first three or four days. When the upper part of the pile is completely inflamed, a row of holes, each of which has a diameter of two inches, is made around it at a few inches below the top, and the opening at that part is closed up. The flame then gradually descends to the circle of holes, and its arrival there is announced by a very perceptible diminution of smoke and vapour. Another row of air holes is then made at a distance of six or eight inches below the first row, which are closed up, and the same operation is repeated until the flame has been conducted to the lowest part of the pile, which generally happens in about a fortnight; when the whole is carefully covered until the fire is extinguished. Such pieces as are not completely charred, are separated, and reserved as fuel for the next pile.

The charcoal produced from the truncheons is laid aside for particular uses; and that obtained from the brushwood is sold, under the name of small coal, as fuel.

In France there is some difference in the mode of preparing the charcoal: it therefore is worth while to give an outline of the various processes there adopted.

The wood is cut down in large faggots, and after having been well dried for some months, it is divided into brushwood, small and large faggots. The last are cut into truncheons of three or four feet in length. The turf is then taken off a square or circular space, having a diameter of about fifteen feet, and the earth beaten until the surface becomes dry and solid. A stake is next fixed in the middle of the area, and some brushwood laid on the surface as a foundation for the remainder. A stratum of truncheons is then laid on the brushwood, and the same alternatives are repeated, until the pile is completed to the height of about six feet, in the form of a truncated cone or pyramid. As soon as this is done, the whole surface of the pile is covered to the thickness of about two inches with dry earth, over which sods are very compactly laid, except at the base, where considerable spaces are left between them. The central stake is now withdrawn, and the cavity is filled with chips, which are lighted at the top; the whole of the chips become inflamed, and after a considerable quantity of smoke has been poured out, a light flame rushes from the chimney in the centre of the pile; the aperture of which is immediately closed by laying a piece of turf over it.

During the next ten or twelve hours, considerable attention is necessary to prevent any mischief resulting from the sudden disengagement, and consequent combustion of carburetted hydrogen, which take place during that period of the manufacture. The explosion is announced by a rumbling noise, and seldom does any other injury than that of throwing off some portion of the covering, and through the opening thus formed flame and smoke issue. It is necessary to close up all such openings with a few spadefuls of dry earth. When the smoke decreases, and the explosions have entirely ceased, the interstices between the sods at the lower part of the pile must be closed. At this stage little attention is required, the combustion gradually extends to the surface, and in about thirty or thirty-four hours after the process commenced the whole pile becomes a glowing mass. The wood is thoroughly charred, the whole is covered with dry earth, and in four or five days it may be taken down. The particular stage at which it is proper to do so, is determined by making a small opening into the pile: if no flame appears, it is fit to be taken down; if it bursts forth, the aperture must be again closed, and allowed to remain so for another day.

Great nicety is requisite in the preparation of charcoal for the manufacture of gunpowder and other delicate chemical processes. And the manufacturers select the stems of the willow, alder, dogwood, and some others, which they prepare with peculiar care. In most of the large manufactories, the charcoal is distilled from iron vessels; by which means it is obtained in a state of considerable purity, and the other products are saved. As all charcoal contains minute portions of earthy and metallic substances, lamp black is commonly used in nice chemical experiments. Lamp black is obtained by the turpentine manufacturers, from the combustion of the refuse of their operations in furnaces appropriated to that purpose. The smoke deposits itself on the sacking which is hung up; it is swept off, and sold for common use without further preparation. The lamp black in this state contains some oil, which is separated by being heated to redness in a close vessel.

The chief consumption of charcoal is as fuel. It is also employed as a tooth powder, and to purify tainted meat. No mode of preparation for the first of these objects is at all necessary, and for the two last, it must merely be reduced to a fine powder.

It forms a part of all reducing fluxes. It is an indispensible constituent of gunpowder. (See Gunpowder.) It is the basis of most black paints and varnishes. It is used to polish brass and copper, and is an excellent clarifier.

Powdered charcoal must be heated to redness in a covered crucible, with an opening in the middle of the cover, and kept in that state till no flame issues out; it must be then withdrawn, allowed to cool, and then put into close vessels and kept for use. Whenever either wine, vinegar, or any other fluid is to be clarified, it is simply to be mixed with the liquor; a froth appears at the surface, and after infiltration, it is pure and colourless. See *Philosophical Magazine*, vol. iii. p. 1. No. 17. &c.; *Annales de Chimie*, vols. xxxi. xxxii. xxxvi. xlii.; Nicholson's *Journal*, 4to. vol. iv. (c. m.)

CHARENTE, the name of one of the departments of France, which was formed out of Angoumois, and takes its name from the river Charente which passes through it. It is bounded on the north by the departments of the two Sevres and Vienne, on the west by Lower Charente, on the south by Lower Charente and Dordogne, and on the east by Dordogne and Upper Vienne. It extends about 56 miles from south-west to north-east, and its mean breadth is about 30 miles. It contains 6310 square kilometers, or about 1,153,684 square acres. The principal rivers are the Charente, the Vienne, and the Touvre. The Charente is navigable from Angouleme to the sea, and is of great service in transporting from Limousin to the port of Rochfort the wood which is required for ship-building. The source of the Touvre is a noble spring, nearly equal to that of Vaucluse, and having its water cold in summer and warm in winter. The forests of this department occupy about 24 thousand hectares, the half of which belong to individuals, and the other half to the nation. The contributions in 1803 amounted to 2,978,069 francs. Population 332,000. The principal towns are Angouleme, Cognac, Ruffec, Confolens, and Barbezieux. See Angoumois for an account of the productions of this department. (*j*)

CHARENTE, Lower, a maritime department of France, formed out of Aunis and part of Saintonge. It is situated on the north of the river Gironde, and is bounded on the north by the departments of the two Sevres and La Vendee, on the west by the sea, on the south by the departments of the Gironde and the Dorgogne, and on the east by the department of Charente. It is about 80 miles long, and is 10, 20, and in some places 40 miles broad. It contains 7200 square kilometers, or 475 square leagues of 2000 toises. The principal productions of the department are corn of all kinds, wines, hemp, flax, brandy, salt, fish, and iron. The isle of Oleron is very fertile; and the isle of Ré, which also abounds in wines, is famous for the liqueur called anisette. The navigable rivers are the Gironde, the Charente, the Boutonne, which is navigable from St Jean D'Angeli to Charente, the Sevre Niortaise, and the Seudre, which is navigable from Mornac to the sea. The forests occupy 38,000 hectares, belonging almost wholly to individuals, about one fifteenth ouly being the property of the communes and the nation. The contributions in 1803 were 4,105,914. Population 402,000. The principal towns are Saintes, Rochefort, Rochelle, St Jean D'Angeli, Marennes, and Jonsac. See Rochefort and Rochelle. (*j*)

CHARIOT. See Carriage, Circensian Games, Coach, Olympic Games, and War-Chariot.

CHARLEMAGNE. See France.

CHARLES I. and II. See Britain.

CHARLES V. See Germany and Spain.

CHARLES XII. See Sweden.

CHARLESTON, the capital city of South Carolina, one of the United States of America, is situated on a tongue of land, formed by the confluence of the rivers Ashley and Cooper. These two streams, short in their course, but wide and navigable, unite immediately below the city, and form a spacious and convenient harbour, communicating with the ocean below Sullivan's island, which it leaves on the north, seven miles southward of Charleston. A sand-bank at the mouth of this harbour, extending from shore to shore, is very dangerous to vessels, particularly when the wind blows strong into the harbour. It is composed of hard sand; but has four openings, by which vessels are navigated across it. The deepest of those openings has fourteen feet of water when the tide flows, and twelve feet when it has ebbed; in spring tides it is covered to the depth of twenty feet. Immediately before this bank there is excellent anchorage ground, of which, however, ships seldom venture to avail themselves, unless the wind be faint, and the billows moderate. From the sand-bank up to Charleston, the anchorage is good, and is best in the immediate vicinity of the town.

Charleston was founded in the year 1680, by the first groupe of colonists who emigrated from England to South Carolina. They had landed about the year 1670, near Port-Royal, from which they removed in the following year to the western banks of Ashley river. There they laid the foundation of a town, the site of which still retains the name of Old Charleston; but finding it inaccessible to large vessels, they renounced it for Oyster Point, where they founded the present city. In the construction of the houses of Charleston, the first object of attention is to moderate the excessive heat. For this purpose, the windows are made open; the doors pass through both sides of the houses; the upper part of the house is sheltered by large galleries from the rays of the sun, and only the cooling north-east wind is admitted to blow through the rooms. In the formation of the streets, less attention has been paid to the peculiarities of climate and situation. The principal streets extend in a straight line from river to river, and thus open agreeable prospects to the east and west. These streets are intersected by others nearly at right angles, dividing the town into a number of squares, which have dwelling-houses in front, and office-houses and small gardens behind. In general, however, they are most uncomfortably narrow; and the pernicious effects resulting from the want of a free circulation of air in that burning climate, are greatly increased by the slovenly negligence of the inhabitants. Cleanliness is not much attended to either in the houses or in the streets; and the burying-grounds in the midst of the town frequently present the disgusting spectacle of carcases uninterred. Fortunately the deficiency of the police is in some measure remedied by the voracity of the turkey buzzard, which devours the carcase before it has time to putrify; and the inhabitants regard with a kind of veneration the useful bird, which thus saves them the trouble of being cleanly.

Fire, whose ravages, though dreadful at the time, often contribute essentially to the improvement of ill-built towns, has been extremely useful in this respect to Charleston. At various times, whole streets have been burned to the ground; and have always been replaced by others more spacious and elegant. Several of the modern streets, too, are as wide as any in the world; and experience will certainly teach the inhabitants the necessity of greater attention to their own comforts. The houses, though mean in their external appearance, are in general commodious and well furnished. Some of those recently built can even boast of a degree of elegance. The most remarkable public buildings are an exchange, a state-house, an armoury, a poor-house, and an hospital for orphans.

The site of Charleston, though originally a mere quagmire, is now drier and more elevated than any other part of the low country of South Carolina. This salutary change has been effected, partly by draining, and partly by the accumulation of offals and rubbish. Creeks and ponds have been converted into solid land, and afford now firm and dry foundations for extensive streets.

The society in Charleston is extremely agreeable. The inhabitants are distinguished by frankness, politeness, and hospitality. Its superior salubrity attracts numbers of planters from the surrounding country; and its vicinity to the Leeward Islands, makes it a favourite resort for rich West Indians. From these causes, it is the gayest town in the United States; and there are few places where social amusements, and refined and elegant pleasures, can be enjoyed in greater perfection. In science and literature the inhabitants of Charleston are as far advanced as any of the Americans. As yet, indeed, they have few literary institutions; but a spirit of improvement has lately arisen among them, which promises the most beneficial consequences. A medical society was instituted in Charleston in 1789, and incorporated in 1794. It meets monthly, when a conversation takes place on the prevailing diseases; the meteorological observations of the members are examined and recorded; and a medical question or subject is discussed. Under the auspices of this association, a botanical society was formed and incorporated in the year 1805. From the medical society it received three hundred dollars, fifty dollars per annum, and a large field which had been presented to them by a lady, to be cultivated as a botanic garden. This institution has flourished beyond the most sanguine expectation; and the garden is now enriched with a considerable number of plants, both indigenous and exotic, arranged according to the system of Linnæus.

For 120 years after the first settlement of South Carolina, Charleston continued to be the seat of government. The great increase of population to the westward, however, made it desirable that the residence of government should be in a more central situation. The beauty, salubrity, and convenience of Columbia, as a point of general communication, recommended it as the most proper site for the new establishment. A city was immediately begun; and the legislature convened there for the first time in 1790.

Charleston was incorporated in 1783, and divided into three wards, which choose as many wardens, from among whom the inhabitants elect an intendant of the city. The town-council is composed of the intendant and wardens, who have power to make and enforce bye-laws for the regulation of the town. The value of exports from this city amounted, in 1794, to 3,846,392 dollars. Its population was computed, in 1791, to be 16,359 inhabitants, of whom 7684 were slaves. Long. 80° 2′ West. Lat. 32° 50′ North. See Ramsay's *History of South Carolina*. Liancourt, Duke de la Rochefoucault's *Travels in North America*. Morse's *American Geography*. Morse's *American Gazetteer*. (*k*)

CHARTS. See GEOGRAPHY and MAPS.

CHARTRES, a city of France, in the department of the Eure and Loire; is situated upon the river Eure, over which is a bridge built by the celebrated Vauban. The houses have a very singular appearance, from the great number of crosses. The principal curiosity of this town is the church of Notre Dame, with its two spires, one of which is the admiration of strangers, from its enormous mass, and from its pyramidal and finely tapering form; while the other is admired for the strength of its architecture, and the richness and delicacy of its ornaments. A fine piece of sculpture by Bridaut, the subject of which is the assumption of the Virgin, adorns the principal altar of this church. The arabesque figures engraven on the pillars are singularly beautiful, and a magnificent groupe on white marble is reckoned the masterpiece of the celebrated sculptor Coustou. The Marshal Vauban considered the bold construction of the spire of St Andrews as one of the wonders of France. The river runs beneath the vault which supports it; and bodies are preserved in the cavern constructed in the thickness of this vault. Great quantities of serges are manufactured in the surrounding villages. In the neighbourhood of Chartres are situated Anet and Maintenon, places celebrated by Diane de Poitiers, and Madame de Maintenon. The aqueduct of Maintenon is very superb, but is not yet finished. Population, 15,000. (*w*)

CHARYBDIS. See Messina.

CHATHAM. See Rochester.

CHATTERTON, Thomas. This astonishing young man was born on the 20th of November 1750. His father was originally a writing usher to a school in Bristol; afterwards a singer in the cathedral; and lastly master of a free school in the same city. He died three months before his son was born. Young Chatterton was slow in attaining the first rudiments of learning; and it was not till he had been delighted with the illuminated capitals of an old manuscript, that he took to learning his letters. This circumstance, and his being taught from an old black-letter Bible, no doubt contributed to his future fondness for antiquities. At eight he was removed to a charity-school, where he was taught reading, writing, and arithmetic. About his tenth year he began to display a fondness for reading; and before he was 12, had gone through about 70 volumes, chiefly on history and divinity. He had also begun to versify at that age; and before leaving school, had picked up some knowledge of music, drawing, and arithmetic. Already the grave and melancholic turn of his mind had displayed its prematurity. At 12 years of age he was confirmed by the bishop, and appeared to feel all the solemnity and importance of the occasion. In his 15th year he left school, and was articled to one Lambert, a scrivener in Bristol, in the lowest form of apprenticeship. Here he had much confinement, but little actual occupation; and he employed the curious activity of his mind in studying heraldry, and transcribing old English glossaries. The first opportunity which he tried of practising on the public credulity was in 1768, when the new bridge of Bristol was opened. A paper appeared in Farley's journal of that city, entitled a description of the friars first passing the old bridge, taken from an ancient manuscript. It was traced to Chatterton, who, it appears, was examined with little ceremony, and even with threats upon the subject. Who were the brutal characters who could hold out menaces to a child on such an occasion, we are not informed; but Chatterton answered them disdainfully, while he pretended to give satisfactory explanations to those who treated him with more mildness. Those explanations, it is true, were contradictory; but he at last declared that he had found the paper in a chest from Redcliffe church. These manuscripts of Redcliffe church formed the great pretext of Chatterton's subsequent forgeries. In the monument of the church of St Mary Redcliffe, Bristol, founded or rebuilt by W. Canynge, a merchant of the 15th century, six or seven chests had been deposited, one of which was called Canynge's coffer. In 1727, the keys of this coffer having been lost, it was broken open by authority, and some title deeds were taken away; but a number of manuscripts were left to casual depredation. The father of Chatterton had removed baskets full of those parchments, using them afterwards as covers to books. Among those parchments young Chatterton, whose mind was now labouring with a plan of deceiving the public, pretended to have discovered the poetry of Rowley, a priest of the 15th century. He communicated some of his pretended treasures to a Mr Catcot, a pewterer of Bristol, and to Barret, a surgeon, both ignorant and credulous judges, who in return supplied the youth with some books and money, and introduced him into better company than he had been accustomed to keep. At his request, Mr Barret lent him also some medical books, and gave him a few instructions in surgery. The course of his studies was now enlarged, and he employed his pen, both in prose and verse, for the Town and Country Magazine.

Encouraged by this partial success in his native city, he addressed (in 1769) a letter to the Hon. Horace Walpole, offering to furnish him with a history of a series of eminent ancient painters at Bristol, and enclosing specimens of the Rowleian poetry. Walpole sent him a polite answer, requesting farther information. In the mean time, he shewed the specimens of poetry to capable judges, who pronounced them forgeries; so that when Chatterton wrote to him again, relating the circumstances of his life, and soliciting his patronage, Walpole replied in a cold monitory epistle, which he intended to close their correspondence. He set out to Paris, however, neglecting to return the manuscripts, which occasioned two successive letters from Chatterton, in the latter of which he demanded back the writings, in terms which Walpole chose to consider offensive and insolent; so that he inclosed the papers to Chatterton, without deigning to write to him. This is the whole story of their connection. Undoubtedly, Walpole might have been more courteous towards a youth whose circumstances would have appeared interesting to a liberal mind; and after neglecting to restore the papers before going abroad, he ought, on his return, to have made an apology. But though his conduct was cold, it cannot be pronounced criminally negligent; for Chatterton came to him in a questionable shape. The odium against Walpole, which occasioned his published Vindication of his Conduct respecting Chatterton, was carried to a most unjustifiable violence. After this event, the stirrings of Chatterton's mind vented themselves in froward communications to the Magazine, consisting of personal and political satire, to which he added some Saxon poems in the manner of Ossian, from his pretended Rowley. A change at this early period of life took place in his religious belief; he became a deist, and connecting infidelity with despair, he avowed his determination of terminating a miserable life by self-destruction. On perusing this threat, which he left in a last will or testament, his master, the attorney, dismissed him from his office and house, after he had continued there two years and nine months.

Reanimated by this emancipation, and by the promises of some London booksellers, he laid aside his project of suicide, and with the hopes and plans of a literary adventurer, came to the metropolis, aged 17 years and five months. His letters during the first few weeks after his arrival describe the most sanguine prospects, and a multiplicity of literary employments; a History of England, a History of London, Essays in the daily papers, and Songs for the public gardens, were his actual or projected tasks. An extraordinary elevation was given to his spirits, by the notice which his political principles attracted from the Lord Mayor Beckford, to whom he was introduced. On this, as on every other circumstance which filled his heart with high anticipation, he wrote with much affection to his mother and sisters, promising they should be partakers in his future fortune, and even sending them presents at times, when there was every probability that he was himself nearly in want of the necessaries of life. During two months from the date of his arrival, it appears from the list of his communications to public papers, and from his songs, &c. that he was industrious in the midst of this intoxicating dream of success. But his hopes had been probably founded in the extravagant idea of making himself of political consequence by his writings; and when that delusion vanished, he found that unremitting industry alone would ensure to him a competence among the dealers in literary ware. No delusion is more common to youthful genius than to over-rate its future powers of patient drudgery. Chatterton set out, therefore, with the fire of the racer, but his unequal spirits seem to have sunk under the burthens of the course. The history of his few remaining days is melancholy, but obscure. About the end of July, he removed from a house in Shoreditch, to the house of a Mrs Angel, a sack-maker in Brook-street, Holborn, where he became poor and unhappy, abandoning his literary pursuits, and proposing to go out to Africa as a naval surgeon's mate. He had picked up some knowledge of surgery, and now requested that gentleman's recommendation, which Mr Barret thought proper to refuse. It is certain, that either from want of encouragement from the booksellers, or, which is much more probable, from the gloomy despondency of his mind, he no longer employed his pen, and that the short remainder of his days was spent in a conflict between pride and poverty. On the day preceding his death, he refused an offer from Mrs Angel to partake of her dinner, assuring her that he was not hungry. At that time she believed that he had eat nothing for two or three days. On the 25th of August, he was found dead, in consequence of having swallowed poison. He was buried in a shell in the burying-ground belonging to Shoelane work-house. Previous to his death he had torn all his manuscripts in small pieces.

On the short and tragical career of "*this mighty stripling*," it is impossible to reflect without regret and astonishment. The authenticity of Rowley's poems is now given up. Mr Warton has proved, that, wonderful as it may seem for Chatterton to have written them, it is impossible that they could have been written by Rowley; and these must have been composed by the boy of Bristol before he had completed his 16th year. Some deduction may perhaps be made from the admiration with which they are contemplated through the medium of an antiquated language; but the intrinsic value of some of those pieces is sterling, independent of all considerations either of their author's age, or of the veil of language which softens their defects by obscurity. Among these is the ballad of *Sir Charles Bawdin*. The heroic conception of character, the simple and well-chosen incidents, the pathos and picturesqueness of this poem, would do honour to the matured imagination of the greatest genius. The chorus in *Godwynne*, beginning,

> "When Freedom drest in bloodstain'd vest—
> To many a knight her war-song sung," &c.

is fraught with the boldest spirit of lyrical enthusiasm

His life (says Lord Orford) should be compared with the powers of his mind; the perfection of his poetry; his knowledge of the world, which, though in some respects erroneous, spoke quick intuition; his humour, his vein of satire, and above all, the amazing number of books he must have looked into, though chained down to a laborious and almost incessant service, and confined to Bristol, except for the last five months of his life. The rapidity with which he seized all the topics of conversation then in vogue, whether of politics, literature, or fashion; and when, added to all this mass of reflection, it is remembered that his youthful passions were indulged to excess, faith in such a prodigy may well be suspended, and we should look for some secret agent behind the curtain, if it were not as difficult to believe that any man possessing such a genuine vein of poetry, would have submitted to lie concealed while he actuated a puppet, or would have stooped to prostitute his muse to so many unworthy functions. But nothing in Chatterton can be separated from Chatterton. His noblest flights and his sweetest strains, his grossest ribaldry and his most common-place imitations of the productions of magazines, were all the effervescence of the same ungovernable impulse which, cameleon-like, imbibed the colours of all it looked upon. It was Ossian, or a Saxon monk, or Gray, or Smollet, or Junius; and if it failed most in what it most affected to be, a poet of the 15th century, it was because it could not imitate what had not existed. (*n*)

CHAUCER, Geoffrey, the Morning Star of English poetry, was born in London in 1328. His descent appears, from the name, to have been Norman; and his father, though variously described, was most probably a merchant. At what university he studied, is a disputed point which even Mr Tyrwhitt has left unsettled. Leland and Warton place him at Oxford, without adducing any proof. His signature of Philoginet of Cambridge, affixed to his first poem, *The Court of Love*, is brought by other biographers as direct testimony that he studied at the other university; but the signature, it should be remembered, is fictitious in point of name, and might be equally so in point of date.

Leland, who is so often inaccurate, tells us that he studied in France. Mr Godwin undertakes to prove this doubtful part of his history, from the circumstance of a Parisian education being so commonly given to young Englishmen in those days, and from Chaucer's fluently speaking French. The reader will admit these proofs at his own discretion. The presumption of Chaucer's having studied at the Temple, and the story of his having been fined whilst a student there, for thrashing a friar in Fleet-street, rest also on the weakest authority.

The precise time at which he attracted the notice of Edward the Third, and of his munificent patron John of Gaunt, is not ascertained, but he certainly enjoyed that patronage before his thirty-first year, as appears from the date of his poem, entitled, *The Dream*, an allegory alluding to the nuptials of John of Gaunt with Blanche heiress of Lancaster. The same poem contains an allusion to the poet's own tender attachment to the lady whom he afterwards married. This was a daughter of Payne de Rouet, king at arms for the province of Guienne. She was maid of honour to Philippa, Queen of Edward III. and youngest sister to Catharine de Rouet, who was first the mistress, and afterwards the wife of John of Gaunt, and by her marriage with that prince, an ancestor of the royal family of England. The supposition of his having been early patronized at the court of Edward, is countenanced by many passages in his poems, describing a residence, which coincides with that which tradition has ascribed to him at the royal abode of Woodstock, in the lodge near the park gate. There is some reason to presume that he accompanied his warlike monarch in the invasion of France in 1359, in a military character. From the record of his evidence in a military court, discovered by one of his latest biographers, (Godwin,) we find that he gave evidence to a fact which he had witnessed in France in the capacity of a soldier. The expedition of 1359, however, which terminated in the peace of Bretigni, gave him little opportunity of seeing service, and he certainly never resumed the profession of arms.

In his thirty-ninth year he received from Edward the Third a pension of twenty marks per annum, a sum probably equal in effective value to two or three hundred pounds of modern money. In the patent for this annuity, he is styled by the king *Valettus Noster*. *Valettus*, Mr Tyrwhitt thinks, is a contraction of *vassalettus*, the diminutive of *vassallus* The name was given, though not as a badge of service, to young men of the highest distinction before they were knighted. Chaucer, however, at the date of that pension, was not young, being thirty-nine years of age. How long he had served the king in that or in any other station, and what particular merits were rewarded by this royal bounty, are points equally unknown. Chaucer, at the time of receiving his first pension, must have been thirty-nine. He did not acquire the rank of scutifer or esquire till five years after, when he was appointed the king's envoy to Genoa. So respectable an appointment seems to imply, that he had established a personal and political character of some importance; but the particular objects of his mission, it has puzzled all his biographers to discover. Mr Godwin, whose life of the poet is a series of suppositions, supposes that it related to commercial objects, and is decidedly of opinion that he visited the northern parts of Italy, and had a conference with Petrarch. But the reality of this interview, pleasing as it is to the imagination, is more than doubtful. It is said to be implied in a passage of one of the *Canterbury Tales*, in which the speaker says, that he learned his story from Petrarch, a learned clerk of Padua. It should be noticed, in the first place, that Chaucer, making one of his pilgrims deduce his tale from Petrarch, does not amount to a declaration from himself as author, that he derived it from that source. The story originally belongs to Boccaccio, and was only translated into Latin by Petrarch, and, like the plan of the *Canterbury Tales*, is in all probability borrowed from the same author. On the other hand, the accurate Tyrwhitt, though he doubts whether Chaucer ever went upon his mission, yet admits, that, supposing him to have been at Genoa, it is to be presumed that he would have seen the first literary character of the age; and it is remarkable that the time of this embassy in 1373, is the precise time at which he could have learned this story of Petrarch at Padua. Neither Petrarch nor his biographers, however, have mentioned the fact, nor did the author of *Memoires pour la Vie de Petrarque* ever fulfil his promise of proving the interview. His genius as a poet, and, we may suppose from the style of his writings, his amenity as a courtier, also kept him in prosperity during the whole of Edward the Third's reign, and indeed during the whole period of John of Gaunt's influence. In 1374, the year after his appointment as envoy, he was presented by the crown with an allowance of a pitcher of wine daily, a grant which was commuted during the succeeding reign to an annuity of twenty marks. He was appointed in the same year to the comptrollership of the customs of wool and skins in the port of London. In the next year he received 104*l.* for the wardship of Sir Edward Staplegate's heir; and in the following year, some forfeited wool to the value of *l.* 71 : 4 : 6. In the last year of Edward's reign, he was sent with Sir Guichard Dangle. His situation in the middle part of his life must thus have been opulent and honourable. It was so opulent, he says himself in his *Testament of Love*, as to enable him to maintain a plentiful hospitality. But the picture of his fortune was reversed during a considerable part of the reign of Edward's successor. He was not, it is true, immediately deprived of his comptrollership on the accession of Richard the Second; his pension was renewed to him, and a grant of money made to him in lieu of his daily pitcher of wine. But these favours were obtained by the influence of John of Gaunt, an influence which lasted but during a few years under the new king. We find him, however, in 1382, receiving a grant of comptrollership of small customs in the port of London; with the additional favour, that the new office might be performed by deputy. Neither is it true that he was obliged to receive a royal protection from his creditors within two years of Richard's accession. This error in former biographers, is one of the few things which Mr Godwin proves in his voluminous biography. He was certainly attached, as his patron was, (for a time,) to the opinions of the reformers, which became unpopular at court, under Richard. The immediate cause of our poet's misfortunes seems to have been his interfering in a dispute between the court and the city of London, in which Chaucer embraced the civic side. This came to a violent crisis in 1384. John of Northampton, a popular candidate for the mayoralty of London, was supposed to be attached to the tenets of Wickliffe. Richard and his court, who detested the Londoners, were resolved that they should have a mayor of a different description. They succeeded in forcing upon the city another candidate, Sir Nicholas Brembar, and the contest subsided, after some resistance on the part of the popular leaders, which was dignified with the name of a rebellion, in the death of some of them, and the imprisonment of John of Northampton. There is a mystery over this court as it is connected with Chaucer's life; for though his writings testify that his subsequent exile and misfortunes arose from it, yet we find him, in 1385, permitted to execute his office by deputy, at a time when there is reason to believe that he was in exile on account of his politics. It is certain, however, that he was arrested and committed to the Tower on his return to England. When obliged to fly, he escaped first to Hainault, then to France, and finally to Zealand. While in Zealand, he maintained some of his countrymen who had fled thither on the same account, a liberality which soon exhausted his money. In the mean time, the partizans of his cause whom he left at home, contrived to make their peace, not only without endeavouring to procure him a pardon, but without aiding him in his poverty abroad. On his return home, he suffered a temporary confinement, and in 1386 he was deprived of his two comptrollerships. The coincidence of this date with that of the Duke of Glocester's usurpation of power, would lead us to suppose that Glocester was personally more hostile to the poet than the king himself was, whose asperity was probably softened by the good offices of his queen, Anne of Bohemia, the friend of Chaucer, and the subject of his warmest panegyric. In 1388, he was obliged to dispose of his two pensions, which were all the resources left to him by his persecutors. From 1386 to 1389, Richard the Second had been stript of his authority. The latter year was propitious to Chaucer. Before its conclusion, John of Gaunt, now Duke of Lancaster, who afterwards married his sister-in-law, returned from Spain, and from that date he had a more steady protector. Before Lancaster's arrival, he had procured his liberation from prison, on terms which have been alleged to be disgraceful to his memory. He made a confession of his coadjutors in what was called Northampton's conspiracy. But in naming them, he implicated no innocent person; and it is evident that they had behaved towards him in the most unprincipled manner.

In the same year, 1389, he was appointed to be clerk of the works at Westminster, and in the year following to the same office at Westminster. His salary amounted to 36*l.* 10.*s.* per annum, a sum (considering the price of provisions in those days,) probably equal in effect to seven hundred pounds of our *present paper currency.* His resignation of this office brings us to the sixty-third year of the poet's life. He then retired most probably to Woodstock, and devoted the repose and evening of his life to writing his immortal *Canterbury Tales*, among those beautiful scenes which had inspired his youthful genius. In 1394, he obtained a pension for life of 20*l.* One of the most curious particulars in the concluding part of his life is, the patent of protection granted to him by Richard the Second, in the year 1398, which has been generally supposed to be a protection against his creditors. But this protection proves, upon examination, to contain no mention of the poet's debts or creditors; and though it is difficult to suppose what other sort of protection a man of peaceable pursuits could require, yet it is one of the many problems in his history which remain yet to be solved. The record shows, however, that Chaucer, though now seventy years of age, had once more embarked in public business, although the nature of his employment is not specified. In the autumn of the same year, he received a grant of a yearly ton of wine, we may suppose in lieu of the daily pitcher which had been stopped during his misfortunes. The place appointed for this delivery seems to imply, that his residence was then in London.

The succeeding year, 1399, was marked by the deposition of Richard the Second, and the ascension of Bolingbroke, the son of his patron John of Gaunt, to the English throne. It is creditable to the memory of Henry IV., although he abandoned so many of his father's friends, that he did not suffer the poetical ornament of the age to be depressed by the revolution. Chaucer's grants of the annuity and pipe of wine were renewed in the first year of the new reign, and an additional pension of forty marks a year was conferred on him. But he did not live long to enjoy them. He died, according to the inscription on his tomb-stone, in the beginning of the second year of Henry IV., at London, on the 25th of October, 1400, and was interred in Westminster Abbey, south-cross aisle. The monument to his memory was erected above a century and a half after his decease, by Nicholas Brigham, a gentleman of Oxford, and a warm admirer of his poetry. It stands at the north end of a magnificent recess, formed by four obtuse foliaged arches, and is a plain altar, with three quatrefoils and the same number of shields. The inscription and figures on the back are almost obliterated.

Chaucer, it will be hardly necessary to inform any of our readers, found the poetry of England (if the metrical romances and rhyming chronicles of the Norman school deserve that name) in the rudest state. Of the measures of verse which had been established by his predecessors, he deigned only to adopt one, the eight syllable measure, and another still shorter and more imperfect; but the latter he introduces in his *Canterbury Tales* only as a specimen of the common minstrel style, in derision. He introduced the majestic ten syllable iambic into our language, which, although it may be sometimes found among the hobbling and indetermined measure of older versifiers, evidently occurs only by accident. He found, however, the numbers of the language more defective than its stores of fancy and fiction. Fable and imaginary characters had been already engrafted on English minstrelsy, through the joint influence of the troubadours, and of the expansion of intercourse among nations, among whom England had taken a distinguished lead since the period of the first Richard. This increasing intercourse and diffusion of taste and fancy, as well as knowledge, throughout Europe, is to be remarked in the influence which the Italian poets possessed upon Chaucer's character as a poet, both as it tuned his versification and enriched him with subjects.

Chaucer's earliest production, *The Court of Love*, was written at eighteen years of age. There yet existed, as we have already noticed, no form of versification in English that could direct his ear in the stately and regular measure of the prolonged iambic.* It was reserved for the youthful hand of our poet first to array them in English, and to ornament them with that inverted form of rhyme which was borrowed from the French and Italians. *The Court of Love* seems to have derived its name from a custom peculiar to the days of early chivalry, viz. courts or parliaments of love. These institutions, whimsical as they appear to a serious age, decided questions of gallantry and attachment that were proposed to them, in the same manner as modern academies pretend to determine questions of literature. The obedience that was paid to them was voluntary, the result of public respect for the arbiters; but the questions argued before them were commonly fanciful. Chaucer's poem reminds us of the institution. It is an allegorical dream, in which the poet supposes himself summoned by Mercury to visit the court of love at Mount Citheron, where he meets with a number of votaries, is introduced to a mistress, and sworn to observe the twenty statutes of the god. These include fidelity to his mistress, implicit belief in her virtues, promptitude to fight, to swear either truth or falsehood for her honour, to say that the crow is white if she says so, and to do the duties of love seven times in a night. The poet objects to this statute alone, and pleads his inability. Among the attendants at the court are placed, with a bold impropriety, but evidently for the sake of contrast, a crowd of monks and friars, and those who lament their obligation to celibacy from other causes. The poet does not leave the court till he forms an assignation with his mistress, and with the celebration of that meeting the poem concludes, "The season is May," and the birds sing a service in concert to the god of love, which, strange to say, is from the Roman Catholic ritual. The nightingale sings, *Domine labia;* the possinjay, *Cœli enarrant;* and the turtle dove, *Tu autem.* The materials of the piece are meagre, extravagant, and ill united. We see, however, in the lover's refusal to the hardest statute of love, and in the deplorable picture of the monks, some promise of the arch and salacious humour which sports so indulgently in the *Canterbury Tales.* We have been thus particular in noticing the earliest production of our earliest poet.[*]

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* To prevent obscurity, we notice to those who may not know the classical names of metres, that long iambic means our common heroic measure, such as the line,

"Sweet Auburn, loveliest village of the plain."

His next production, in order of time, is the story of *Troilus and Cresseide*, in which Chaucer has claims on our curiosity were it only for being the precursor of Shakspeare and Dryden, in telling, though differently, an interesting tale. It is, however, the best of Chaucer's productions next to the *Canterbury Tales*, and was for ages the favourite of the English nation.[†] Troilus, one of the sons of Priam, is supposed, during the siege of Troy, to fall in love with a beautiful widow,[‡] Cresseide, whose father, the poet, in defiance of antique story, makes a Trojan, and supposes to have deserted from his native city to the camp of the Greeks. The Trojan prince sees her in the temple of Minerva, and is irrecoverably smitten with her appearance, naturally lovely, but made more interesting by the grief for her father's desertion. The uncle of Cresseide is the bosom-friend of Troilus; he visits him, finds him in despair, and, sacrificing duty to friendship, obtains, by a long train of artifices, the happiness of Troilus from the yielding virtue of Cresseide. Calchas, however, sends for his daughter from Troy; she is exchanged for a Greek prisoner; after bidding a secret and tender adieu of the prince, and taking an oath of constancy, which, like many other mistresses, she forgets, and repairing to the camp of the Greeks, transfers her affections to Diomed. Troilus learns her infidelity, and dies in despair. The story concludes disagreeably, and is tediously told; but it is interspersed with a number of interesting and deeply pathetic passages. Though the scene and subject are connected with classical and heroic story, the poet describes no pomp nor circumstances of war, but such as are immediately necessary to usher in his hero to the notice of his mistress with better effect, returning victorious from the field; and he seems to describe the temple of Minerva, only for the sake of introducing the beauty in a greater attitude of solemnity. Like the true poet of love, he magnifies the importance of domestic scenes, and neglects war and public circumstances, except where they serve as auxiliaries to that passion which

"Drives ambition with its pomp away;
Unless conducive to his ampler sway."

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[*] A specimen of the best part of it may not be unacceptable to those who are little invited by his obsolete language to explore an almost unintelligible author. In describing the life of lovers, he thus proceeds:

This is the life of joy that we ben in,
Resembling life of heavenly paradise;
Love is elixir aye of vice and sin,
Love makith hertis lustie[||] to devise;
Honour and grace have they in every wise,
That ben to lovis law obedient.
Love makith folke benigne and diligent,
Aye stirring them to dreadin vice and shame;
In their degree it makith them honourable,
And sweet it is of love to bear the name,
So that his love be faithful, true, and stable.
Love prunith hym to seemin amiable,
Love hath no faulte there it is exercised,
But sole with them that have all love despised.

[†] The poet pretends to have borrowed this story from the Latin, which is exceedingly improbable. But should we ascribe its origin, as Mr Tyrwhitt has done, to Boccaccio, still the merit of much originality in point of manner would remain to Chaucer. Chaucer himself professes, that he was indebted for the tale of *Troilus and Cresseide*, to his Auctor Lollius: he declares,

"That of no sentiment I thus endite,
But out of Latin in my tongue I write."

Of the writings of this Lollius nothing is known. He certainly was not the Lollius Urbicus of the 3d century; and though mentioned again by Chaucer in his *House of Fame*, his existence as a real writer seems still to be questionable. Mr Warton lays no stress on Chaucer's mention of his *Auctor*, but from having seen some of the name Italianized in a MS. of the poem which he had perused, he pronounces its origin to have been Italian. Mr Tyrwhitt directly charges Chaucer with forging the name of Lollius, and concludes, that he borrowed it from the *Philostrato* of Boccaccio. Mr Godwin again quotes the evidence of Lydgate to controvert Tyrwhitt's opinion; but Mr Godwin has not observed that Lydgate's evidence goes no way to prove the authenticity of Lollius. Lydgate says, that Chaucer borrowed it from a book called *Trophe*, in the Lombard tongue. The two assertions of Chaucer and of Lydgate are indeed direct, but they go in opposite directions.

[‡] Mr Warton, when he speaks of this character in Chaucer's poem, does not seem to have attended to several circumstances which, at the outset of the story, distinctly point out Cresseide to have been a widow, not a virgin. Mr Godwin, from the same misapprehension, though he dwells on the real intrigue of the story with great equanimity, is indignantly shocked at a passage which he denominates brutal, in which the poet declares his uncertainty whether Cresseide had ever been a mother before her affair with the Trojan prince. There is, however, nothing brutal in this passage; the poet only suggests a doubt whether or not the young widow had been left with a few small children Cresseide speaks of her widowhood in several places. She says on one occasion, when invited to a public amusement, "*Let maidens gen to dunse and yongè wives.*" And to Diomed, she speaks in direct terms of her former lord, evidently not alluding to Troilus, (with whom all her interviews had been stolen,) but of a plain lawful partner.

"But as to speak of love I wis, she said,
I had a lorde to whom I wedded was,
The whose mine heart was all till that he died."

[||] Pleasure

The scenery and names in *Troilus and Cresseide* are Trojan, but the sentiments and manners are purely modern and chivalrous. In one place we hear of jousts and tournaments, in another of the parliament of Troy. Cresseide is found by a noble anachronism reading the Thebais of *Statius* during the Trojan war. In the speeches, there are frequent allusions to bishops, scholastic divinity, the devil, and other ideas still more modern than Statius. Next to the length of the poem, the greatest obstacle to our interest in it is an inconsistency between the strength and tenderness, and the lawlessness and secrecy of Troilus's passion. The poet represents no sufficient cause to prevent the Trojan from marrying Cresseide. He dies of love for her, and yet declares no honourable passion. This is a departure from nature and probability, the more remarkable in a poet whose characteristic merit is generally adherence to both. Yet this tale of Troy divine, which Sir Philip Sydney adored, and which was once regarded as an ornament of our language, did not fascinate our forefathers without a reason. As an ancient novel in verse, it reminds us very frequently of the minute touches and pathos of Richardson. The confession which Cresseide makes of her attachment in the scene of felicity, has been noticed, deservedly, by Warton as exceedingly beautiful.

> Cresseide all quite[a] from every dride and tene[b],[*]
> As she that justé cause had him to trist[c],
> Made him soche feast, it joy was for to sene[d],
> When she his trouth and clene intent ywist[e].
> And as about a tree with many a twist
> Bitrent[f] and writhen[g] is the sweet woodbinde,
> Gan eche of 'hem[h] in armis other winde.
>
> And as the new abashed nightingale,
> That stintith[i] when she beginneth sing,
> When that she herith any herdis tale,
> Or in the hedges any wight stirring;
> And after sikir[k] doth her voice onstring,
> Right so Cresseide, whan that her dredé stent,[l]
> Opened her hert and told him her intent.

The grief of Troilus at her departure, is most naturally pourtrayed:

> Where is mine owné lady, lefe, and dere?
> Where is her whité breast? where is it, where?
> Where ben her armis, and her eyen clear,
> That yesterday this timé with me were?
> Now may I weep alone with many a tear,
> And grasp about I may, but in this place,
> Save a pillowé, I find nought to embrace.

His sensations on arriving at her house, when, instead of finding her returned, he sees the barred doors and shut windows giving token of her absence, and his hurrying precipitately from the distracting sight, are well conceived and described:

> Therewith when he was ware, and gan behold
> How shut was every window of the place,
> As frost, him thought his heart began to cold,
> For which, with changed dedly paly face,
> Withouten worde he forthe by gan to pace,
> And as God would, he gan so fast to ride,
> That no wight his continuance aspide.[m]
> Then said he thus, O palace desolate!
> O house of houses, whilom best ydight![n]
> O palace empty and disconsolate!
> O thou lanterne of which queint[o] is the light!
> O palace whilom day that now art night!
> Well oughtest thou to fall and I to die.——

It would be unprofitable to enter minutely into all the poems of Chaucer, which are numerous as well as individually large. His *Dream*, which is supposed to be an epithalamium on the marriage of John of Gaunt, is an allegory of very childish and grotesque fancy. He dreams of an enchanted island, which is visited by a knight, and invaded by Cupid, who brings a formidable navy, and wounds the queen. The knight departs, after obtaining a promise of marriage from the queen; but returning in a ship, which has the convenient property of enlarging or contracting its dimensions, he finds the queen has changed her mind. The knight commits suicide at the news, and the queen expires. While their bodies are surrounded by mourners, a beautiful bird enters, and sings over the bier of the queen, but returning back, dashes against a window, and falls down lifeless. Another bird enters, and restores the dead one, by putting a seed into its mouth. This furnishes a hint for restoring the knight and queen, who are revived and married with great splendor. Such was the style of allegory that was tolerated in the infancy of our poetry. It certainly appears, at first sight, to have as little connection with John of Gaunt as with John o' Nokes, and to be abundantly foolish.

The *Boke of the Duchess* is another dream, intended to commemorate the sorrow of his patron for the same Lady Blanche, who is heroine of the former story. He dreams that he has been led into a forest by the sound of the hunting horn, and that a dog who comes and fawns upon him, leads him to the foot of a tree, where he finds a melancholy knight, evidently John of Gaunt, who laments to him for the loss of his partner. This poem also is dull, but it contains one description of a forest landscape, in a very sprightly style.† The *Assembly, or the Parliament of Birds*, is another poem devoted to the story of his patron's attachment. It commences with a lofty abstract from the Somnium Scipionis; and after describing the parliament, or meeting of birds, to choose their mates on Valentine's day, tiresomely touches the amour of the royal pair under the similitude of eagles.

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[*] When the final e, which is now silent in our language, but which in Chaucer's poetry seems to be arbitrarily silenced and sounded as it suits his purpose, is pronounced as it is accented in the specimens we have quoted, the versification will read as smoothly as much later poetry.

[a] *Quite*, free.
[b] *Tene*, grief.
[c] *Trist*, trust.
[d] *Sene*, see.
[e] *Ywist*, knew.
[f] *Bitrent*, twined.
[g] *Writhen*, wreathed.
[h] *'Hem*, them.
[i] *Stintith*, stoppeth.
[k] *Sikir*, assured.
[l] *Stent*, stopt, ceased.
[m] *Aspide*, espied.
[n] *Ydight*, graced.
[o] *Queint*, extinguished.

† The poet describes himself as led into a forest,

> Where there were many grene greves,‡
> Or thick of trees, so full of leaves;
> And every tree stood by himselve
> Fro other well ten foot or twelve.
> So great trees and so huge of strength,
> Of forty or fifty fathoms length,
> All clean withouten bowe or stick,
> With croppis broad and eke as thick;
> They werin not an inch asunder
> That it was shade ovir all undir.
> And many a harte and many a hinde
> Was both before me and behinde:
> Of fawnis, sowris,§ buckis, does,
> Was full the wood, and many roes
> And many squirrilis, that sate
> Full high upon the trees and ate.

‡ *Greves*, groves.

§ *Sowris*, bucks four years old.

The *Romaunt of the Rose*, is a fine translation from the French allegory of John de Meun and William de Lorris, representing the dangers and difficulties of a lover.

The *Flour and the Leaf* is another allegory, founded on mysterious allusions to the virtues of the vegetable world. The plan of the poem is ascribed by Warton to a French original; and the peculiar style of French poetry from which it is deduced, is supposed by the same critic to be that of the *Chants Royaux Balades Rondeaux* and Pastorals, which Froissart and others cultivated as the provençal poetry declined. The fancies with which this poem is filled, (says the same author,) seem to have taken their rise from the floral games instituted in France in the year 1324, which filled the French poetry with images of this sort. They were founded by Clementina Isaure, Countess of Tholouse, and annually celebrated in the month of May. She published an edict, by which she assembled all the poets of France in artificial arbours, dressed with flowers, and the successful poet was rewarded with a flower made in gold. There were also inferior prizes in silver. This fantastic institution soon became common over the whole kingdom of France.

The best of Chaucer's allegories (and we long to have done with them) is his *House of Fame*, which Pope has so elegantly modernized. Warton has injuriously compared Pope's imitation to the modern ornaments in the venerable pile of Westminster Abbey. Analogies drawn from one art to another, are unsafe guides in matters of taste, and of all analogies we deprecate those chiefly which are drawn from brick and stone. We will not suffer the later poet to be condemned by so arbitrary a comparison. Pope has not indeed the merit of originality in his *Temple of Fame*; it is doubtful if even Chaucer drew it from invention or translated it. What is most bold and pleasing in Chaucer's piece, is the conception of the palace of Fame; of the rock of ice on which the perishable names of grandeur were engraven; his theory and explanation of the expansion of sounds, spreading in circles through the air like the rings on water, when a pebble is cast into it, till it reach the abode of Fame; the house of Rumour for ever shifting round. These ideas, and the claims of the petitioners at the tribunal of Fame, are modernized by Pope with an addition, not a loss of dignity. In some respects, the judgment of Pope has improved upon the original. Chaucer supposes himself snatched up to heaven by an immense golden eagle, which addresses him in the names of St James and the Virgin Mary; but presently quiets the poet's apprehensions of being carried off to Dan Jupiter like Ganymede, or stellified like Orion, by assuring him that Jove wishes him to sing of other subjects than of Venus and blind Cupids, and has ordered him to obtain a sight of the house of Fame. The philosophy of Fame appears in Pope with much more propriety, coming from the mouth of the poet himself, than from the beak of a talkative eagle.

We now come to his immortal *Canterbury Tales*. The subject of that work, it will be hardly necessary to inform any reader, is the journey of a number of travellers, who are going on a pilgrimage to Canterbury, and who agree, at the suggestion of a jovial landlord, to tell stories by the way, with an agreement, that the one who tells the best story should have a supper at the common expence on their return. The plan is borrowed from Boccaccio, who first introduced in his *Decamerone* the dramatic form of novel writing; but whatever be the merit of Boccaccio's stories, his gentlemen and ladies in the Decamerone are spiritless portraits, compared to those of Chaucer. The Italian poet's characters are true gentlemen and ladies, as similar to each other as old shillings, from which the polish of society has effaced every stamp of originality. In comparing the merit of the different tales, Dryden pronounces the highest panegyric on the Knight's story, while those of the Squire and Miller have been honoured by the preference of Warton. The former has been immortalized by the notice of Milton himself, viz. the story of Cambuscan bold. The enumeration of the pilgrims at the opening of the poem has no rival in description drawn from familiar life. The groups of Homer's heroes, and of Milton's devils, are more astonishing, but not more perfect in their kind. The scene is full without confusion, varied with the appearance of accident, but with consummate art. Never were drawn together a company so completely fitted to be the representatives of the entire state of society at one period. A fine unobtrusive but sufficient contrast is supported between the characters; as between the demure society of the prioress and the jovial laxity of the wife of Bath; the rudeness of the shipman and the polish of the knight, &c.; but it is a contrast arising out of nature, not an antithesis betraying intention. The dramatic conduct of the piece deserves uncommon approbation. Among nine-and-twenty travellers, it would have been unnatural and improbable if some disagreeable humour had not broken out. The introduction of two quarreling characters, the Sompnour and the Frere, two descriptions of the priesthood which in those days were at deadly enmity, affords both a spirited and amusing break in the lounging sociality of the other pilgrims, and an occasion for the poet to indulge his satire on all parts of the church, by employing its members to ridicule each other. The Frere, intolerant, coarse, and abusive, takes an opportunity of hinting, like a modern methodist, that the soul of his antagonist is doomed to hell. The Sompnour indignantly, but with far more successful wit and humour, tells a story of a canting hypocritical friar, and exposes the mendicant fraternity to derision. The story is low even to grossness, but is very laughable. Of all the characters, the Wife of Bath is perhaps drawn in the strongest and broadest lines of the poet's humour; and if we could venture to censure Pope for any failure in his imitation of the old bard, it would be in having missed the proper aspect of this incomparable dame.

Chaucer's merits as a poet are great and various, but they are all inferior to his power of delineating living character. His landscapes are pleasant; his feasts and tournaments are picturesque; but his men and women are not inferior even to Shakspeare's in comic spirit and resemblance to nature. He is sometimes pathetic, and Warton gives an instance of his sublimity, but the passage is chiefly borrowed from Statius, and is mixed with much incongruous matter. After such terrific images as

> " The slayer of himself yet saw I there,
> His heartis blood ybathed had his hair;'

after "Woodnesse laughing in her rage;" after exhibiting the burning of ships, and the desolation of cities, he introduces the "cooke scalded for all his longe ladle." But Chaucer lived when taste was in its childhood.

He was the great architect of our versification. He understood the genius of his native language, and adapted it to those structures of rhyme, which some whimsical projectors in the age of Queen Elizabeth would have demolished, in order to substitute a Latin form, but which Spenser in his better judgment followed and improved.* A groundless objection was made to his style by an old critic, that he introduced cartloads of French words into our language. It is a satisfactory answer to this, that the language of England in his time was deeply intermixed with French. In the reign of Edward the Third, French and English were taught together at schools; and it was usual to make the scholars construe their Latin into French. A Norman-Saxon dialect must have been in fact the accustomed language of the upper classes, and it was to them that Chaucer wrote. Spenser thought differently of his style from the critic to whom we have alluded, when he pronounced it the "*Well of English undefiled*." The fluctuation of language easily accounts for this being less strictly true at present than 200 years ago. In general his words in a single sentence clearly reach the meaning to which they point, and he is only fatiguing because he multiplies sentences, and spins out descriptions. This, however, like the coarse part of his humour, was more the fault of his age than of himself. While the beauties of style in more refined classics meet and surprise us at every turn, those of Chaucer may be compared to flowers which we collect in a long journey, numerous in the sum, but collected widely asunder. This expression may appear irreverend to those who are enamoured of old English and obsolete spelling, merely because it is old and obsolete; but the reader who sits down to Chaucer, expecting wonders in every page, will find, that though there is much to reward his patience, there is also something to exercise it. (*z*)

CHECK, or Cheque, in the manufacture of cloth, a very extensive variety of fanciful goods, made from all the different substances used in the manufacture, sometimes separately, and sometimes combined in the same fabric. Checks are made by forming stripes in the warp, either of yarn of different fineness, or of different colours. In the cotton manufacture, handkerchiefs checked of various colours form a very extensive branch of the business, and are distinguished by the general name of *pullicate*, from the Indian article of which they are imitations. Those which combine the most extensive variety of colours, for the same reason are called *Madras pullicates* or *handkerchiefs*. The ground of the Madras handkerchiefs is a pale buff colour, very like that of the plain cotton cloth known by the name of nankeen, or nanquin; and in the real Indian manufacture, the buff ground is not the effect of any chemical process of dyeing or tinging, but the natural colour of the cotton. In the British imitations, the ground of the cloth is woven white, and afterwards tinged before finishing. The most extensive branch of check manufacture, however, is of that coarse kind which is used for shirts by seamen, and exported in very great quantities to the West Indian colonies, for various articles of negro clothing.

From the very great quantities of these coarse stuffs which are annually consumed, it forms a very prominent branch both of the linen and cotton manufacture. The English cotton checks are chiefly manufactured at Blackburn, and other villages in Lancashire; and the principal seat of the check manufactory, especially the coarser kinds, in Scotland, is at the town of Kirkaldy in Fifeshire. The extensive demand for this article, and the coarseness of the fabric, renders it peculiarly an object for those economical improvements by which a reduction of price may be obtained, without preventing those employed in it from obtaining by their labour fair and competent means of subsistence. It seems, for this reason, to be one of the most inviting objects for the application of the recently introduced operations of weaving by power, although, as far as we know or have reason to believe, this has not hitherto been attempted. For this reason, we shall here explain the principles of an invention made some time ago by the author of this article, at the request of a friend who was engaged to a considerable extent in the power weaving of plain calicoes for printing. It was not put in practice, by the death of the person for whose use it was intended; and other pursuits have hitherto prevented the inventor from taking any steps to bring it into practice.

To fit a loom moved by power to the operations of weaving checks of every description, from the most simple pattern of blue and white, for a seaman's or a negro's shirt, to the most variegated pattern of a Madras handkerchief, it is only necessary to add to the loom a very simple apparatus for moving the various shuttles, so as to work alternately according to the pattern required. This apparatus will be found in Figures 1. and 2. Plate CXL.; and the inventor offers it with the less hesitation or diffidence, because, although he admits that it has never been practically applied to this purpose, yet he has used and proved one of a much more complicated and diversified nature, with unequivocal success, and entirely upon a similar principle, in the patent tambouring machinery, where the effect produced was greatly more difficult of accomplishment. The figure is a profile section, taken longitudinally, of the frame-work of a power loom of that kind which was originally introduced in Cheshire and Lancashire, and is known there by the name of the *Stockport loom*. In Scotland, it is generally called the *Crank loom*, from the means by which the motion is communicated. The upper rail, or cape of the loom, is represented at AA, and the hanging part, or, as it is called by weavers, the sword of the lay, at B. Supposing that a pattern combining five colours is required, and that, of course, five different shuttles are requisite, a section of a box with five divisions, distinguished by numerals, will be seen at C. This box is to be placed on a centre pin at 1, and by moving it backward and forward, the separate divisions from 1 to 5 may be successively brought into the working position, that at 3 being represented in that situation. Let D be a wheel of a convenient diameter, with a ratchet wheel on its rim. This wheel may be made of well-seasoned wood; but, although more expensive, cast-iron will be greatly preferable. With the lower part of the box-frame the lever E is connected by a common joint; and by means of two iron pins or studs, the motion for shifting the boxes will be derived by the rotation of the wheel D on its own axis. This motion will be given at each motion of the lay by the hook H, connected with the lever G by two intermediate cranks at L and M. The vibration or oscillatory motion of the lay, generated by the revolution of the crank F, is represented by the two dotted lines drawn from the centre on which it swings. Now when the lay swings forward towards the wheel D, the pin in the end of the lever E will come in contact with the piece of wood or metal which is screwed on the wheel at 3. Let another vibration of the lay between the dotted lines take place, and the piece of wood 4 will be presented to the pin in the end of the lever E. This piece being nearer the circumference of the wheel D than the former, the pin will be sooner stopped; and the lay continuing its motion to the dotted line, it is evident that the frame of boxes must move upon its centre, and the box 4 will then occupy the place which the box 3 now does, and thus the shuttle will be instantaneously changed, without for one second impeding the speed of the loom. When the wheel D is again shifted, the piece 5 will present itself to the pin, and again instantaneously shift the frame, to present a new shuttle in the box 5. Let the lever E be lengthened, and another pin placed so as to come in contact with the inside of the second range of pieces on the wheel D, and the boxes will be successively shifted from 5 to 1 in the inverted order of the former shift. This, however, will not be effected when the lay comes forward to the cloth, but when it is again thrown back towards the heddles; and the shift will take place immediately before the shuttle receives the impulse which is to throw it across the cloth. Now a little reflection will make it apparent, that a wheel of this description may be fitted to every possible diversity of pattern, merely by giving the ratchet wheel as many teeth as necessary, and screwing pieces to move either pin between the concentric circles on the wheel which correspond to the box to be presented. If the wheel is made with a number of slotted holes diverging from the centre towards the circumference, the pattern may be very speedily altered from one description to another, and very few wheels will be required for each loom. The spring K will keep the frame of boxes steady in the position where it is placed until a fresh shift is requisite. An apparatus of this kind might be added to any of the power looms now in use; and there seems no reason to doubt that it would fit them for a much more extensive range of work than they have been hitherto applied to.

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* Spenser seems at one period to have been a convert to the plan of naturalizing the Latin hexameter in our poetry, but he certainly changed his mind.

The small Figure 4 is a profile of the wheel D and lever E, and will further illustrate how the stop pieces act upon the pins at both extremities of the vibration.

It seems rather extraordinary that no plan of this nature has as yet been adopted; and it can only be accounted for by reflecting how very precarious every new invention is, from a variety of causes both in its mechanical and economical relations. The extensive use to which this might be applied, even in its most simple state, for weaving low-priced blue and white checked cloth must be evident, when we reflect that these checks supply the men employed in the navy, amounting to upwards of 130,000, with shirts and trowsers; that most of the labourers and operative mechanics wear the same kind; and that it supplies the negroes in the colonies with their chief and almost only clothing; that it furnishes a very useful part of the dress of females employed in almost every branch of domestic industry; and that, besides being an article of dress, it is also, among the most numerous class of people, very much in use for bed-hangings, window-curtains, and many other kinds of household furniture. (J. D.)

CHEESE. See DAIRY.

CHEIRANTHUS, a genus of plants of the class Tetradynamia, and order Siliquosæ. See BOTANY, p. 255.

CHEIROSTEMON, a genus of plants of the class Monadelphia, and order Pentandria. See BOTANY, p. 265.

CHELIDONIUM, a genus of plants of the class Polyandria, and order Monogynia. See BOTANY, p. 228.

CHELMSFORD, the county town of Essex, is delightfully situated at the confluence of the rivers Chelmer and Cann, the former of which is crossed by a bridge, originally built by Maurice, bishop of London, but rebuilt in 1787. The town consists of four principal streets, and possesses several elegant public buildings. The shire hall is a handsome edifice, and contains apartments for the courts of assize and session, and also the corn exchange, and the assembly rooms. Its front, which is built with white stone, has a basement of rustic work, and a pediment sustained by four three quarter Ionic columns. The church, dedicated to St Mary, is a large and elegant building. The body of the church was erected in 1803, in place of the more ancient part, which fell down in 1800. It has a square flint tower at its west end. On the Moulsham side of the Chelmer stands the county gaol, which was begun in 1773, and contains all those accommodations which are now almost every where extended to persons in confinement. Two extensive barracks have been recently built here, one at the west end of the town, and the other on the south side, both of which can accommodate 4000 troops. At a short distance from the last of these barracks commences the line of embankment, with the batteries and parapets which were erected for the defence of the metropolis. The other public buildings in Chelmsford, are the free grammar school, endowed by Edward VI. in 1552; a charity school for 50 boys, founded in 1713; a charity school for 20 girls, founded in 1714; and a neatly sculptured conduit, (with the figure of a naiad at the top, and several appropriate inscriptions,) to which the water is conveyed from a spring at the distance of a quarter of a mile. At Galleywood Common, near Chelmsford, there is a race course, on which three plates are run for annually, and one of them of the value of 100 guineas is given by the queen. Number of houses 822. Population in 1811, 4649; males 2046, females 2603; females employed in trade 533. See Gough's *Additions to Camden's Britannia*, vol. ii. p. 55; and Brayley and Britton's *Beauties of England and Wales*, vol. v. p. 256. (*j*)

CHELONE, a genus of plants of the class Didynamia, and order Angiospermia. See BOTANY, p. 248.

CHELTENHAM, a town of England in Glocestershire, celebrated principally as a watering place, is situated near the river Chilt, or Chelt, which runs into the Severn at Wainlode. The town is pleasantly situated, and is sheltered on the north-east by the Cotswold Hills, which terminate about two miles to the north-east of Cheltenham. The town consists only of one street, which is about a mile in length, and during the last 20 years the buildings have been progressively improving. The hotel, and the lodging houses, are commodiously and elegantly fitted up; the assembly rooms are large and handsome; and the theatre has been lately completed on an enlarged plan. The church, dedicated to St Mary, stands to the south of the centre of the town, and is a large building, consisting of a nave, chancel, side aisles, and transept, with a square tower rising from the intersection, and terminating in a lofty octagonal spire, which deviates considerably from a vertical direction. There is in the north transept a beautiful circular window 15 feet in diameter, divided into 33 compartments. There is an ancient stone cross near the church, consisting of a single shaft rising from the centre of a flight of steps. The walks in the church-yard are shaded with double rows of lime trees. The other public institutions are, an hospital for six poor men and women; a free school founded in 1574; and the Cheltenham repository established in 1800.

The numerous invalids who resort to Cheltenham, principally between the months of May and November, are supplied from three springs, which were discovered at different periods. The medicinal qualities of the Spa were first discovered in 1716. This spring rises about six feet below the surface of a meadow, about half a mile south of the town, and is an excellent purgative chalybeate. It was enclosed by a rail in 1718, and in 1738 a brick pavilion on five arches was built over the well, a convenient room was fitted up for the reception of the company, several walks were formed, and a long avenue of lime trees was planted. Another spring was discovered in 1788 at the depth of 50 feet, more copious than the former, and possessing all its medical virtues. A third spring was discovered by Dr Thomas Jamieson in 1803, which contains a greater proportion of sulphureous gas than any of the rest. Population of the town and parish in 1811, 8325. See Brayley and Britton's *Beauties of England and Wales*, vol. 5. p. 675; and *Tour in Wales*, in Philip's *Coll. of Voy*. vol. iv. p. 17. (*w*)

CHEMISTRY,

Is the science which treats of those events or changes in natural bodies, that are not accompanied by sensible motions. Its object is to ascertain the constituents of bodies, and the laws by which the simple atoms of matter unite together and form compounds.

Neither the origin nor primitive meaning of the word *Chemistry*, in Greek *χημια*, or *χημεια*, is accurately known. That it was used by the Greeks, at least soon after the commencement of the Christian era, is certain; and many reasons coincide to render it probable that it was of Egyptian origin.

It is certain, that the *χημια* or *chemistry* of the ancients, was the name of an art of some kind or other. Suidas, a Greek writer of the ninth century, mentions this particularly in his Lexicon, under the word *χημεια*. He informs us, that it was an Egyptian art, practised at least as early as the third century: for Dioclesian, he tells us, ordered all the chemical books of the Egyptians to be sought out and burnt, because they had rebelled against him.

A great many circumstances, which it would be tedious to adduce here, render it probable, that the word *chemistry*, among the Egyptians, was, at a very early period, nearly equivalent to our phrase *natural philosophy* in its most extensive sense, and comprehended all the knowledge of natural objects which they possessed. It is well known, that among the Egyptians all science was confined to the priests, who, considering it as a sacred deposit, took every precaution to conceal it from the people. It is possible, that this was the reason why natural philosophy got from them the name of *Chemistry*, which, in Plutarch's opinion at least, implied the *hidden* or *secret science*.

Of the progress which natural philosophy had made among the Egyptians, it is impossible for us at this distance of time to judge. The secrecy which they observed, precluded their improvements from being fully detailed by other nations; and all their genuine records and writings have been lost and destroyed, in the shock of the numerous revolutions to which that hapless nation has been subjected. Some gleanings may indeed be gathered from the writings of Herodotus, Plato, Diodorus Siculus, Plutarch, and other Grecian philosophers, who were indebted for their information to the Egyptian priests, and from Eusebius, who has preserved some traces of their writings. From these gleanings, and from the lamp of philosophy which they kindled in Greece, it is evident that they had made some progress in the mathematical sciences; but it cannot be inferred, that they were acquainted with that branch of science which we at present call *chemistry*. They were, indeed, acquainted with various chemical facts; but these had neither been classified nor generalized.

In process of time, the word *chemistry*, as has been the case with many other terms, (the English word *physician*, for instance,) seems gradually to have acquired a more limited and precise signification; and instead of implying the whole of *natural philosophy*, as was originally the case, to have been confined to the *art of working metals*. This gradual change seems to have been, in a great measure, owing to the great importance attached by the ancients to the art of working metals. The founders and improvers of it were considered as the greatest benefactors of the human race; statues and temples were dedicated to their honour; and mankind, in the transports of their gratitude, raised them above the level of humanity, and enrolled them in the number of the gods.

How long the word *chemistry* retained this new signification, we do not know with accuracy. But in the time of Dioclesian, as Suidas informs us, it had acquired another and still more limited meaning, namely, the *art of making gold and silver*. The cause of this new limitation, and the origin of the opinion that gold can be made by art, are equally unknown. The art appears to have been cultivated with considerable eagerness by the Grecian ecclesiastics, to have passed from the Greeks to the Arabians, and by the Arabians to have been brought into the west of Europe. Those who believed in it gradually assumed the form of a sect, under the name of *Alchymists*, a term which is supposed to be merely the word *chemist* with the Arabian article *al* prefixed. Thus the word *chemistry*, originally the same with natural philosophy, was at last, in consequence of a very whimsical revolution, applied solely to the *art of making gold*.

The alchymists laid it down as a first principle, that all the metals are composed of the same ingredients; or rather they affirmed, that the principles which compose gold exist in all the metals, contaminated indeed with various impurities, but capable, by a proper purification, of being brought to its perfect state. The great object, therefore, of their researches, was to find out the means of producing this purification, and consequently of converting the baser metals into gold. The substance which possesses this wonderful property they called *lapis philosophorum*, or the *philosopher's stone*. And many of them boasted, that they were in possession of this grand instrument.

Chemistry, as the term was used by the alchymists, was the *art of making the philosopher's stone*. They affirmed, that this art was above the reach of the human capacity; and that it was made known by God to those happy sages only whom he peculiarly favoured. The fortunate few who were acquainted with the philosophers' stone called themselves *adepti*, *adepts*, that is, persons who had got possession of the secret. This secret, they pretended, they were not at liberty to reveal, affirming that dire misfortune would fall upon that man's head who ventured to disclose it to any of the sons of men, without the clearest tokens of the divine authority.

The alchymists, in consequence of these notions, made it a rule to keep themselves as private as possible. They concealed, with the greatest care, their opinions, their knowledge, and their pursuits. And in their communications with each other, they adopted a mystical and metaphorical stile, and employed peculiar figures and signs, that their writings might be understood by the adepts only, and might be entirely unintelligible to common readers.

Notwithstanding all these obstacles, a great number of alchymistical books made their appearance during the dark ages; many of them under the real names of the authors, but a still greater number under feigned titles, or ascribed to the celebrated sages of antiquity. Though, during the whole of this period, the art of printing was unknown, and books consequently were multiplied with great labour and expence, this does not seem to have much lessened the number of alchymistical tracts. They must, therefore, have been bought up with eagerness, even by those who had no pretensions to the title of adepts; but who were buoyed up by the delusive hopes of becoming masters of the grand secret, and of suddenly rising by its assistance to affluence and distinction.

How far the alchymistical sect had extended among the ancients, or whether it had assumed the form of a sect, it is impossible to say. Traces of it appear among the Arabians, who turned their attention to literature soon after the conquest of the caliphs, and who communicated to our barbarous ancestors the sacred seeds of science. The principal chemical writers among the Arabians were Geber and Avicenna; and in their writings, such of them at least as we have reason to consider as authentic, there appears but little of that mysticism and enigma which afterwards assumed a systematic form.

The alchymists seem to have been established in the west of Europe at least as early as the 8th century. Between the 11th and 15th centuries, alchymy was in its most flourishing state. The writers who appeared during that period were sufficiently numerous, and very different from each other, both in their style and abilities. Some of their writings are totally unintelligible, and bear a stronger resemblance to the reveries of madmen, than to the sober investigations of philosophers. Others, if you make allowance for their metaphorical style, are written with comparative plainness, display considerable acuteness, and indicate a pretty extensive acquaintance with natural objects. They often reason with great accuracy, though generally from mistaken principles; and it is not unfrequently easy enough to see the accuracy of their experiment, and even to point out the particular circumstance which led to their wrong conclusions.

The principal alchymists who flourished in Europe during the dark ages, and whose names deserve to be recorded, either on account of their discoveries, or on account of the influence which their writings and example had in determining the public taste, were Albertus Magnus, Arnoldus de Villa Nova, Roger Bacon, Raymond Lully, and the two Isaacs of Holland.

Albertus Magnus was born in the year 1205, and died in 1280. He was a German, and, during the early part of his life, was so remarkable for his dulness, that he became the jest of his acquaintances. When about 17, he appeared at the university of Paris, where he studied with eclat, and where afterwards he obtained the title of *doctor*. He joined the order of Dominican Monks at Cologne, and was also bishop of Ratisbon. His works are very numerous; but those relating to chemistry are only three tracts. 1. A treatise entitled *De Alchymia*, in which he gives a very distinct account of all the chemical substances known in his time, and of the manner of obtaining them. He describes also, very concisely and clearly, the different instruments then employed by chemists, and the various operations which they had occasion to perform. This treatise, therefore, is of considerable value, because it exhibits with fidelity the state of chemistry in the 13th century. Towards the end, indeed, he falls into the common cant of the alchymists; but even then he uses but little of their ambiguous and metaphorical language. 2. His second treatise is on *Minerals*, and is equally plain and sensible. 3. If the third treatise, entitled *Lilium de Spinis Evalsum*, be genuine, it must have been written at a very different period of life; for it is infinitely inferior to the two others.

Albertus, during one period of his life, taught publicly in the university of Paris, where he is said to have had for a pupil the celebrated Thomas Aquinas, who afterwards wrote several treatises on alchymy, not inferior, in point of mysticism, to the other works of that renowned divine. There are, however, several words and phrases (*amalgam*, for instance) still retained in chemistry, which make their first appearance in his works. And his theories, which are ingenious enough, tend not a little to elucidate the data on which the alchymists went. We find, too, in him the commencement of that combination of astrology and alchymy, which makes so conspicuous a figure in the writings of his successors.

At the same time with Albertus, lived Roger Bacon, by far the most illustrious, the best informed, and the most scientific of all the alchymists. He was born in 1224, in the county of Somerset in England; studied at Oxford, and afterwards at Paris. He became a cordelier friar, and, devoting himself to philosophical investigations, his discoveries, notwithstanding the pains which he took to conceal them, made such a noise, that he was accused of magic, and his brethren in consequence threw him into prison.

His writings display a degree of knowledge and extent of thought scarcely credible, considering the time when he wrote. In his small treatise, *De Mirabili Potestate Artis et Naturæ*, he begins by pointing out the absurdity of believing in magic, necromancy, charms, or any of those similar opinions which at that time were universally prevalent. He points out the various ways in which mankind are deceived by jugglers, ventriloquists, &c.; mentions the advantages which physicians may derive from acting on the imaginations of their patients, by means of charms, amulets, and infallible medicines; affirms that many of those things which are considered as supernatural, are merely so because mankind in general are unacquainted with natural philosophy. To illustrate this, he mentions a great number of natural phenomena which had been reckoned miraculous, and concludes with several secrets of his own, which he affirms to be still more extraordinary imitations of nature. These he delivers in the enigmatical stile of the times, induced, as he tells us, partly by the conduct of other philosophers, partly by the propriety of the thing, and partly by the danger of speaking too plainly. One of these secrets is a description of gunpowder, in language which cannot be mistaken. This was more than a century before Swartz, the German, who got the credit of the discovery, even existed.

Arnoldus de Villa Nova lived at the same time with Roger Bacon. He was a physician, and seems to have been born at Villeneuve, a village in Provence, about the year 1240. He travelled through Spain, France, and Italy, and afterwards taught publicly in the university of Montpellier. His reputation as a physician was so great, that his attendance was requested in dangerous cases by different kings, and even by the Pope himself. He was skilled in all the sciences of his time, and was besides a proficient in Greek, Hebrew, and Arabic. When at Paris he studied astrology, and calculating the age of the world, found that it was to terminate in the year 1335. The theologians of Paris exclaimed against this and several of his other opinions, and condemned our astrologer as a heretic. This obliged him to leave France; but the Pope protected him. He died in 1313, on his way to visit Pope Clement V. who lay sick at Avignon. He has got the credit, (though, as far as appears, without deserving it,) of the discovery of spirit of wine and oil of turpentine. But he seems to have been one of the first that introduced these substances into pharmaceutical preparations. All his life long he was passionately devoted to alchymy. His writings on the subject are numerous. They all treat of the philosopher's stone, and are much more obscure than those of his predecessors; though it must be acknowledged that some important facts now and then occur in them. Perhaps the most curious of his tracts is his *Rosarium*, which is intended as a compend of all the alchymy of his time. It is divided into two parts: The first, which treats of the theory of the art, is plain enough; but the second, on the practice, which is subdivided into 32 chapters, and which professes to teach the method of making the philosopher's stone, is in several places unintelligible.

Raymond Lully, who was born at Barcelona in 1235, was a disciple of Arnold, though they were both nearly of the same age, and died almost at the same time. The history of Raymond is very obscure. According to some, he was at first a profound logician, but, being disgusted with the vanity of disputing without end about trifles and absurdities, he turned the whole of his attention to alchymy. He afterwards travelled through France, Germany, and England; and, if some accounts are to be credited, he was at last stoned to death in Africa for preaching Christianity. His chemical writings are very numerous, but the whole of them are so obscure, and abound so much in ridiculous whims and absurdities, that they hardly deserve the labour of a perusal. He seems to have been the first who introduced those hieroglyphical pictures or symbols, which afterwards appeared in such profusion in the writings of the alchymists. He was, however, the discoverer, or at least the first describer, of some very important chemical agents.

John Isaac Hollandus, and his countryman of the same name, were either two brothers, or a father and son. They were born in Stolk, a village in Holland, it is supposed in the 13th century. They wrote various treatises on chemistry, remarkable, considering the time when they lived, for clearness and precision. They describe all their processes with accuracy, and even give figures of the instruments which they employed. This renders their works very intelligible; and they deserve attention, because they exhibit the clearest proofs that many of the processes supposed of much more modern date were well known to them.

These are the principal alchymistical writers. It would be tedious and useless to enlarge the catalogue, as the greater number of their writings are remarkable for nothing but obscurity and absurdity. They all boast that they are in possession of the philosopher's stone; they all profess to communicate the method of making it; but their language is enigmatical, that only the wise may receive instruction, and that they may assist those adepts alone who are favoured with illumination from heaven. Their writings, in those benighted ages of ignorance, gained implicit credit, and the covetous were filled with ridiculous desires to enrich themselves by means of their discoveries. This laid the unwary open to the tricks of a set of impostors, who went about the world pretending that they were in possession of the secret of the philosopher's stone, and offering to communicate it to others for a suitable reward. Thus they contrived to get possession of a sum of money, and afterwards they either made off with their booty, or tired out the patience of their pupils by intolerably tedious, painful, expensive, and ruinous processes. It was against these men that Erasmus directed his well known satire, entitled *The Alchymist*. The tricks of these impostors gradually exasperated mankind against the whole fraternity of the alchymists. Books appeared against them in all quarters, which the art of printing, just invented, enabled the authors to spread with facility: The wits of the age directed against them the shafts of their ridicule; men of science endeavoured to point out the impossibility, or at least the infinite difficulty, of the art; men of learning rendered it probable that it never had been understood; and men in authority endeavoured, by laws and by punishments, to save their subjects from the talons of impostors.

The chemists, of whom we have hitherto spoken, confined their researches chiefly to the metals and to the method of making gold; throwing out, however, occasional hints of the importance of their art in medicine. But the first man who formally applied chemistry to medicine was Basil Valentine. He is said to have been born in 1394, and to have been a Benedictine monk at Erford, in Germany. He wrote various treatises on chemistry, in all of which he applies it to medicine.

The most important and famous of them is, his *Currus triumphalis Antimonii*, in which he celebrates the virtues of antimonial medicines, of which he had been the original discoverer. He first taught the doctrine, that all substances are composed of *salt*, *sulphur*, and *mercury*, which makes so prominent a figure in the writings of some of his successors.

Chemists had for ages hinted at the importance of discovering a universal remedy, which should be capable of curing, and even of preventing, all diseases; and several of them had asserted, that this remedy was to be found in the philosopher's stone; which not only converted base metals into gold, but possessed also the most sovereign virtue, and was capable of curing all diseases in an instant, and even of prolonging life to an indefinite length, and of conferring upon the adepts the gift of immortality upon this earth. This notion gradually gained ground, and the word *chemistry*, in consequence, at length acquired a more extensive signification, and implied not only the *art of making gold*, but the *art* also of *preparing the universal medicine*. Just about the time that the first of these branches was sinking into discredit, the second, and with it the study of chemistry, acquired an unparalleled degree of celebrity, and attracted the attention of all Europe. This was owing to the appearance of that very extraordinary man Theophrastus Paracelsus.

He was born in 1493, near Zurich, in Switzerland. His father, who was a medical practitioner, instructed him in physic and surgery. Conceiving a passion for alchymy, he was put under the care of Trithemius, abbot of Spanheim, and afterwards of Sigismund Fuggerus, from whom he acquired the practical part of the art. Afterwards he visited all the universities of Germany, Italy, France, and Spain, and travelled through almost every country in Europe; consulting indifferently, physicians, barbers, old women, conjurers, and chemists. At the age of 20 he was taken prisoner by the Tartars, and carried before the Czar of Russia, whose son he accompanied in an embassy to Constantinople; where, as he tells us, he was first let into the secret of the philosopher's stone. He now applied himself to the practice of medicine with so much success, that he acquired, in consequence, a very great reputation. The venereal disease had, a little before, made its appearance in Italy, and was now carrying its ravages over Europe, and baffling the feeble attempts of the regular physicians of the times. Paracelsus, previously instructed by Carpus of Boulognia in the method of treating it by means of mercury, cured that formidable disease wherever it presented itself, with comparative ease, and with the most unbounded applause. Opium, too, which he employed with freedom, enabled him to cure, or at least to palliate, many painful disorders.

In the 34th year of his age, when his reputation was at its height, he was appointed by the magistrates of Basle to deliver lectures in their town, and thus was the first public professor of chemistry in Europe; for before that time, the science was not taught in any university. In two years he quarrelled with the magistrates about a medical fee, and left the city. He rambled up and down the country, his disciples gradually forsook him, he sunk into the deepest dissipation, being scarcely ever sober, and never changing his clothes, not even during the night. At last, in the month of September 1541, he died at Saltzburg, after a few days illness, in the 47th year of his age. Though he boasted all his life long that he was in possession of the universal medicine, which he called *elixir proprietatis*, by which he could not only cure all disorders, but prolong his own life to an indefinite length, and he actually talked of living to the age of Methuselah.

It is not necessary to draw any character of this extraordinary man. That he was an impostor, and boasted of secrets which he did not know, cannot be denied; that he stole many opinions, and even facts, from others, is equally true; his arrogance was insupportable, his bombast ridiculous, and his whole life a continued tissue of blunders and vice. At the same time, it must be acknowledged that his talents were great, and that his labours were not entirely useless. He contributed not a little to dethrone Galen and Avicenna, who at that time ruled over medicine with absolute power, and to reinstate Hippocrates on that chair from which he ought never to have risen. He certainly gave chemistry an eclat which it did not before possess; and this must have induced many of those laborious men who succeeded him to turn their attention to the science. Nor ought we to forget, that, by carrying his speculations concerning the philosophers' stone and the universal medicine to the greatest height of absurdity, and by exemplifying their emptiness and uselessness in his own person, he undoubtedly contributed more than any man to their disgrace and subsequent banishment from the science. Just as Mr Hume, by carrying the ideal system to the utmost pitch of extravagance, may be in some measure considered as the occasion of that general reform in metaphysics which has since taken place.

In 1577, or just 36 years after the death of Paracelsus, his great admirer and disciple Van Helmont was born of a noble family at Brussels. He studied medicine contrary to the inclination of his relations, was early distinguished for his extensive reading and great knowledge, and was created doctor of medicine at the age of 22, having previously read public lectures on surgery at Lovain. Soon after, happening to get a slight itch, and perceiving that the regular treatment had no effect upon it, but that sulphur speedily removed it, he became in consequence disgusted with medicine, renounced the study, divided his fortune among his relations, and left his country with an intention never more to return. He spent ten years in travelling; and at last, having acquired a knowledge of chemistry, he became violently attached to it, and resolved to devote to it the remainder of his life. In 1609, he married and returned to Wilwoord, where he employed himself in making chemical experiments, and in applying that science to medicine. His publications soon gave him celebrity, and he was more than once invited to the court of Vienna. He died in 1644, at the age of 67. Like his predecessor Paracelsus, he boasted that he was in possession of the universal remedy, to which he gave the name of *alkahest*. His chemical discoveries were numerous, and justly entitle him to distinction.

Van Helmont may be considered as the last of the alchymists. His death completed the disgrace of the universal medicine, which afterwards, like the philosophers' stone, was considered by all rational chemists as a palpable absurdity. His contemporaries, and those who immediately succeeded him, if we except Crollius and a few other blind admirers of Paracelsus, attended solely to the improvement of chemistry, and the refutation of the absurd tenets of the alchymists. The chief of them were Agricola, Beguin, Glaser, Erkern, Glauber, Kunkel, Boyle, &c.

The foundations of the alchymistical system being thus shaken, the facts which had been collected tumbled into a heap of rubbish, and chemistry was left without any fixed principles, to wander about in the dark, destitute of an object. At last, there arose a man thoroughly acquainted with the whole of these facts, capable of arranging them, and of perceiving the important purposes to which they might be applied, and able to point out the proper objects to which the researches of chemists ought to be directed. This man was Becher. He accomplished the arduous task in his work, entitled *Physica Subterranea*, published at Frankfort in the year 1669. The publication of this book forms a very important era in the history of chemistry. It then escaped for ever from the trammels of alchymy, and became the science which we find it at present.

Thus it appears, that the word *chemistry* has had at different times no less than five meanings. It first signified *natural philosophy;* afterwards it was restricted to the *art of working metals;* at a later period it meant the *art of making gold;* at a still later period, the discovery of *a universal medicine* was also included under it; and, last of all, in 1669, it became the *science* which *investigates the insensible motions of bodies.* Thus, after a variety of transformations, it stopped at last, and now comprehends under it precisely one-half of its original signification. At first it was the name of the whole of natural science, whereas now it is only the name of one of the two branches into which science is divided.

John Joachim Becher, to whom the honour of laying the foundation of the science of chemistry belongs, was born at Spires in 1625, and seems to have been of Jewish extraction. He was first a professor of medicine, then physician to the Elector of Mentz, and afterwards to the Elector of Bavaria. Towards the end of his life, he went to England, and died in London in 1682, as is suspected, in great poverty. His writings testify with what success he applied himself to the study of chemistry.

Ernest Stahl, his disciple, and the commentator of the *Physica Subterranea*, gave the science a degree of order and extension which raised it in some respects to a level with mechanical philosophy, and secured to himself the highest and most exalted reputation. This philosopher, a German, first physician to the King of Prussia, professor of medicine and of chemistry, who was born in the year 1660, seems to have been actuated from his very infancy by a violent passion for chemistry. At the age of fifteen he could repeat, by heart, the whole of the *Chemia Philosophica* of Barnerus, at that time the most popular book on the subject. He attached himself particularly to the writings of Becher, whom he resembled in activity and brilliancy of imagination, and far surpassed in precision and judgment. Becher's theory, in his hands, was new modelled and simplified. He explained the nature of combustion, and reduced the phenomena of chemistry under a certain number of general heads. His system forms as complete a whole, and has as imposing an aspect, as any which has hitherto been promulgated. It was the result of very cautious researches, and was elucidated and confirmed by satisfactory experiment. No wonder, then, that its author attracted general admiration, and that he was dignified with the title of the *sublime* Stahl. His theory consisted in supposing, that a certain substance, called *phlogiston*, forms a part of all combustible bodies; that its separation constitutes *fire*, while its various combinations produce most of the other phenomena of chemistry. It was first developed soon after the commencement of the 18th century; and Stahl's *Fundamenta Chemiæ* were first published in 1723. For a period of almost fifty years after the appearance of that book, the sole object of chemists was to confirm and extend the theory of the author. And it applied so happily to their different discoveries,—enabled them in many cases to foretel the event,—and assisted them so much to penetrate into the still unexplored recesses of nature, that we have no reason to be surprised at the admiration which it excited,—at the attachment which chemists displayed for it,—and the violence with which they supported it.

A system of chemistry, published in 1732, contributed, perhaps, as much as the theory of Stahl, though in a very different way, to the improvement and subsequent popularity of chemistry. This system was written by Boerhaave, one of the most accomplished philosophers, and perhaps the most celebrated physician, that ever flourished in modern Europe. A surreptitious copy of his chemical lectures having been printed by some of his pupils, he was under the necessity, in 1732, of revising and publishing his system of chemistry: a system which contained a much fuller collection of chemical experiments, and more exact directions for repeating them, than any previously offered to the world. The bounds of the science were enlarged by this acute philosopher, who had stored his mind with the principles of mechanical philosophy. His account of fire, of thermometers, and other similar chemical instruments, was excellent, considering the period in which he wrote.

The taste for chemistry which these celebrated men had inspired, together with the numerous academies and societies of different kinds all over Europe, who dedicated a portion of their time to chemical researches, occasioned numerous publications on that subject, and several discoveries of importance were the result. The science became more and more respectable, and the Stahlian theory was more completely developed, especially in Germany and in France, where several chemists of eminence successively cultivated the science. Among the German chemists, none holds a higher rank than Margraaf, a member of the Berlin Academy, to whom we are indebted for some very important discoveries. He first had the courage to call in question the authority of Stahl; and his experiments on phosphorus destroyed one of the strong holds upon which the Stahlian theory depended. Rouelle and Macquer, two Frenchmen, and associated teachers, were scarcely less celebrated; the first as a skilful practical chemist, the second as an eloquent lecturer. The first may be considered as the founder of the chemistry of animal bodies as it exists at present. When he published his analysis of urine and blood, he had scarcely any model. To Macquer, born at Paris in 1718, we are indebted for an elementary treatise on chemistry, written with such simplicity and perspicuity, that it stamped the form of subsequent works, and was even used in the different universities of Europe. We are indebted to Macquer also for a dictionary of chemistry, first published in 1766, which contributed in no common degree to the improvement of the science. In this work, the different chemical substances and instruments were described,—the theories were explained and examined,—the improvements still wanted were pointed out—the errors and imperfections were stated with a clearness and warmth which never fail to interest the reader. This dictionary was translated into Italian, German, and English; and the translators, who were all well acquainted with the subject, rendered it still more complete by their valuable notes.

Chemistry was still far from being on a footing with mechanical philosophy. The reasoning employed was often loose and unsatisfactory, and frequently amounted to nothing more than far-fetched and ill-conducted analogies. The correction of these faults required all the influence of a man who had been accustomed to the rigid accuracy of mathematical demonstration,—whose profound mind had embraced every part of human knowledge,—whose sound judgment could not be biassed by prejudice,—whose industry was not to be overcome by fatigue, or want of health,—whose candour and love of truth were not to be shaken,—and who generously sacrificed himself to the improvement of the sciences. Nor need we name this philosopher. Every one who is not a total stranger to chemistry must have heard of Bergman, whose very name is a sufficient panegyric. This illustrious Swede was born in 1735, at Catherinberg, in West Gothland. His father was receiver of the revenues in that province, a post at that time neither very lucrative nor respectable, which induced him to urge his son to assume the profession of law or divinity. Young Bergman accordingly went to Upsal with that intention, and commenced his studies under the inspection of a friend. But he very soon testified a dislike to both the professions for which he was intended, while he manifested a violent passion for mathematics and philosophy. His friend remonstrated with some severity, and pointed out the imprudence of his choice. Bergman listened in silence, but still persevered in his favourite pursuits. His friend deprived him of his books, restricted his studies, and left him only to choose between law and divinity. This restraint almost proved fatal: Bergman's health declined; it was found necessary for him to leave the university, and return home. His relations, finding it in vain to struggle with his inclinations, at last indulged them, and left him at liberty to pursue those studies of which he was so distractedly fond.

At that time Linnæus, after having surmounted obstacles sufficient to have crushed a man of ordinary energy, was in the height of his glory, and was revered every where as the patriarch of natural history. He had infused the enthusiasm which actuated his own breast into the minds of his pupils, and at Upsal every student was a natural historian. Bergman, in particular, attached himself to Linnæus, and bestowed much pains on botany and entomology. This last branch of natural history is deeply indebted to him. He first displayed in it those powers of arrangement which constitute the charm of his works, and that penetration which produced afterwards such important fruits. On his return to the university, he imparted his discoveries to Linnæus, who sent them with a very flattering panegyric to the Academy of Stockholm,—"*Vidi et obstupui!*"

In the year 1761, Bergman was appointed teacher of mathematics and natural philosophy at Upsal. He was in this situation in 1767, when Wallerius, at that time professor of chemistry at Upsal, resigned his chair. Bergman offered himself as a candidate for the vacant professorship. But Wallerius had other plans. There was a relation of his own whom he wished to succeed him, and the professors at Upsal had so much influence, that few doubted but he would accomplish his plan. Bergman, to shew himself qualified for the place to which he aspired, published two dissertations on alum, which were attacked by Wallerius in a style of acrimony altogether unworthy of his reputation. Gustavus IV. late king of Sweden, was at that time Prince Royal, and chancellor of the university. The character and abilities of this extraordinary man, and the zeal with which he sometimes supported men of science, are well known. Fortunately for chemistry, and for the reputation of Sweden, Gustavus took the part of Bergman, on the recommendation, it is said, of Von Swab, who pledged himself to be answerable for his qualifications; and he was so keen on the subject, that he supported his cause in person before the senate. Wallerius and his party were of course baffled, and Bergman got the chair. He filled it with the greatest glory for seventeen years; and, during that period, his numerous publications entirely altered the appearance of chemistry. He introduced an order, a perspicuity, an exactness, which were unknown before, and which were certainly one of the great causes of the subsequent rapid progress of the science. Their influence was universally felt; and, as long as Bergman lived, he stood unrivalled on the continent at the head of the science.

But it was not his publications alone which constituted his merit. His lectures were no less valuable; and many of the pupils whom he educated, contributed, in no small degree, to spread his reputation. Gahn, Hielm, Gadolin, the Elhuyarts, and many others who afterwards acquired celebrity, were educated by him. His first care, after obtaining the chair, was to collect all the different chemical substances, and their products, and to form them into a cabinet. Another cabinet contained the minerals of Sweden, arranged according to the places from which they were obtained; and a third consisted of models of the different instruments employed in chemistry and in chemical manufactures. These were designed for the instruction of his pupils, whom he encouraged and inspired with that confidence and enthusiasm which is necessary for appearing with respectability in the republic of letters. One day he was told by one of his pupils of a young man who resided in the house of an apothecary at Upsal, and who was reproached for neglecting his duties, that he might employ the whole of his time in the study of chemistry. Bergman's curiosity was excited. He paid the young man a visit, and was astonished at the knowledge which he displayed, and the profound researches which he had undertaken, notwithstanding the poverty under which he laboured, and the restraint under which his situation placed him. He encouraged his ardour, and made him his favourite pupil and friend. This young man was Scheele, one of the most extraordinary chemists that ever existed.

He was born in 1742, at Stralsund, the capital of Swedish Pomerania, where his father was a tradesman. Young Scheele, at a very early period of his life, shewed a strong inclination to learn pharmacy, and was accordingly bound apprentice to Mr Bauch, an apothecary at Gottenburgh, with whom he lived eight years. Here he first found the impulse of that genius which afterwards made him so conspicuous. He durst not, indeed, devote himself openly to chemical experiments, but he contrived to make himself master of the science, by devoting those hours to study which were assigned him for sleep. According to the testimony of Mr Grunberg, his fellow apprentice, he was of a very reserved and serious disposition, but uncommonly diligent. He attended very minutely to all the processes,—reflected on them while alone, especially during the night-time,—and read every thing relating to the subject in the writings of Neuman, Lemery, Kunkel, and Stahl. Kunkel's *Laboratory* was his favourite book. He used secretly, during the night-time, to repeat experiments out of it. On one of these occasions, as he was employed in making pyrophorus, another apprentice, without his knowledge, put some fulminating powder into the mixture. The consequence was a loud explosion: the whole family was thrown into confusion, and our young chemist was severely chastised.

From Gottenburg, Scheele went to Malmo, and two years after to Stockholm. In 1773 he went to Upsal, and resided for some time in the house of Mr Loock. Here Bergman first found him,—saw his merit, and encouraged it,—adopted his opinions,—defended him with zeal, and took upon himself the charge of publishing his treatises. He gave him free access to his laboratory, and procured him a salary from the Swedish Academy. Encouraged by this magnanimous conduct, the genius of Scheele, though unassisted by education or by wealth, burst forth with astonishing lustre; and, at an age when most philosophers are only rising into notice, he had completed a career of discoveries which have no parallel in the annals of chemistry. His treatises are perfect models of chemical research, and display an ingenuity, knowledge, and address, which is altogether astonishing. Nothing was capable of baffling his patient industry, or of escaping his penetrating eye.

Scheele and Bergman cannot well be compared together. Their zeal, indeed, for the science, their candour, their love of truth, and their industry, were equal; but Bergman was distinguished by the extent of his views, and by the plans which he formed for the improvement of the science; Scheele, by the skill with which he conducted particular analyses, and the acuteness with which he distinguished substances by their properties. Bergman's views were general; Scheele's were particular. Bergman was the man for drawing the outline; but Scheele understood best how to fill it up. On one occasion, indeed, (we allude to his treatise on *fire*,) he attempted a general subject, but his success was not great. However, the acuteness with which he treated it must be admired; and the vast number of important facts which he brought forward to support his opinion, are truly astonishing, and perhaps could not have been brought together by any other man than Scheele.

Chemistry was deprived of these two illustrious philosophers, Bergman and Scheele, almost at the same time. Bergman died in 1784, at the baths of Medwi, in the 49th year of his age, crowned with glory, after a life spent in the most laborious industry. Scheele was snatched away in 1786, in the 44th year of his age. For about six months previous to his death, he had been severely afflicted with the gout. When he began to perceive that his end was approaching, he was induced, from a principle of gratitude, to marry the widow of his predecessor. The ceremony was performed on the 19th of May, while Scheele lay on his death-bed. On the 21st, he left her by his will the whole of his property; and the same day on which he had so tenderly provided for her, he died. "Thus," says Dr Crell, "in less than two years, the world lost Bergman and Scheele, two men of whom Sweden, rich as she is in great and learned men, has the strongest reason to be proud; two chemists who were equally beloved and lamented by their contemporaries, and whose names will be remembered by the remotest posterity with gratitude and reverence."

While these philosophers were employed in cultivating chemistry in Sweden, discoveries were made in Scotland which changed the apparatus and the mode of reasoning, reduced under the dominion of chemistry a number of invisible substances which had been considered formerly as too subtile for exertion, and thus occasioned a complete revolution in the science. Dr Joseph Black, from whom these discoveries originated, was born in Bourdeaux, in 1728. His father was a native of Belfast, but of a Scotch family residing in Aberdeenshire. Dr Black was educated in Belfast, and completed his education at the universities of Glasgow and Edinburgh. He discovered, after an ingenious investigation, that limestone, and the mild alkalies, are compounds of lime and pure alkalies, with an aërial fluid, to which he gave the name of *fixed air*. This discovery led to the origin of pneumatic chemistry.* Mr Cavendish soon after investigated the properties of fixed air and hydrogen gas. About the year 1770, the subject was taken up by Dr Priestley, who discovered a great variety of aërial fluids, and acquired a most splendid reputation. No man, not even excepting Scheele, ever began the cultivation of chemistry under greater disadvantages than Dr Priestley, and yet few have made more numerous or more important discoveries. He was an obscure dissenting clergyman, extremely unpopular in consequence of his opinions, which involved him in almost perpetual controversy; his income was exceedingly small, yet he was loaded with a family, and obliged to spend most of the day in teaching to be able to support them. He was totally ignorant of chemistry, unprovided with any apparatus, and not in possession of the means of supplying one. These circumstances, which at first sight seemed to preclude the possibility of his entering upon the chemical career, probably when coupled with his great abilities and activity, contributed essentially to his ultimate success.

The splendid discoveries of the British chemists drew the attention of Lavoisier to the subject as early as the year 1770. He repeated and verified all their experiments of importance, together with those of the German chemists. He was early satisfied of the imperfections of the Stahlian theory, with which the new discoveries in pneumatic chemistry could not be reconciled; and after a most elaborate and ingenious investigation, persevered in for a series of years, with the utmost application, he succeeded in establishing a theory nearly the reverse of that of Stahl. For several years after he had satisfied himself of the truth of his opinions, he was not able to produce a single convert either in France or in any other country. At last, Mr Cavendish,† by discovering the composition of water and of nitric acid, removed the grand objections to his opinions, and enabled him to explain his new doctrine in a satisfactory manner. Upon this Mr Berthollet declared himself a convert in 1785. His example was followed by Fourcroy; and in 1787, Morveau, during a visit to Paris, was convinced of his former mistakes, and induced to embrace the same opinions. The example of these eminent men was followed by that of all the young chemists in France. Mr Kirwan, who had acquired a great reputation by his chemical writings, had published a defence of the doctrine of phlogiston. This essay Mr Lavoisier got translated into French, and it was published, with a refutation, by some eminent chemist, at the end of each section. The refutation convinced Mr Kirwan, and induced him to embrace the Lavoisierian theory. His example was followed by Dr Black, and by almost all the eminent British chemists. Indeed, Dr Priestley was almost the only one who did not renounce the phlogistic theory.

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* Whoever reads with attention the chemistry of this illustrious character, as given to the world by the learned Dr Robison, will not hesitate to accede to this position. But Dr Black never received from the French philosophers the credit which was so justly his due. With Virgil he might exclaim

> "Hos Ego, &c.—tulit alter honores."

COXE.

† This illustrious philosopher has been nearly equally overlooked by the phalanx of French chemists, with Dr Black; and, we might almost say, by those of Great Britain; although his writings have added celebrity to the country of his birth. *Ibid.*

Lavoisier and his associates, to make their victory still more certain and complete, invented a new chemical nomenclature, which they proposed, in 1787, as a substitute for the old. This nomenclature they adopted in all their writings. A violent controversy was the result, which terminated in the complete triumph of the French nomenclature in every country in Europe.

Such is a concise view of the progress of chemistry down to our own time. Within these few years, very splendid additions have been made to the science, especially by the sagacity of Mr Davy. And at present, in consequence of the recent and unexpected galvanic discoveries, the Lavoisierian theory stands a considerable chance of being new modelled, if not in a great measure overthrown. Several important and necessary modifications have already taken place, and others not less important will probably follow.

We shall endeavour in this article to give a concise but comprehensive view of the present state of the science. From the uncertainty to which chemical theory is liable, and the improbability of ever being able to reach absolute certainty, though every new modification and improvement is probably an approximation, we cannot avoid falling into error when we attempt to theorise. To this we are particularly liable in one very important branch of the science, that, namely, which treats of *heat*, which is still very vague, even in its best established points. But we shall endeavour to avoid error as far as is in our power, by adhering closely to accurate experimental details, and by pointing out, as clearly as we can, what is certain, from what is still doubtful or hypothetic.

We shall divide this article into three parts. In the first, we shall treat of the elements of the science. In the second, we shall take a chemical view of nature. In the third, we shall give a short sketch of the most important *chemical apparatus*.

PART I.

ELEMENTS OF CHEMISTRY.

As the object of chemistry is to ascertain the constituents of bodies, the way in which these constituents combine, and the nature of the combinations which they form, the science naturally divides itself into three parts: 1. A description of the component parts of bodies, or of *simple substances*, as they are called. 2. An account of the *compound* bodies formed by the union of the simple substances. 3. An account of the nature of the power which induces the particles of bodies to unite. This power is usually called *affinity*. These three particulars will form the subject of the three following Books.

BOOK I.

OF SIMPLE SUBSTANCES.

We are probably ignorant at present of bodies, strictly speaking, elementary or simple. All that is understood in chemistry by a *simple substance*, is a substance not yet decomposed, and which we cannot shew to be a compound. Those of that kind at present known are about forty-eight. They may be divided into two classes; those which can be confined in vessels, and of course exhibited in a separate state; and those which cannot be confined in any vessels that we possess, and the existence of which is only inferred from certain phenomena exhited by the first class of bodies in certain circumstances. The first class of bodies may be called *confinable*, the second *unconfinable*.

DIVISION I.

OF CONFINABLE BODIES.

The confinable bodies may be arranged under the four following heads:

1. Simple supporters of combustion.
2. Simple combustibles.
3. Simple incombustibles.
4. Metals.

These classes shall be treated of in order in the four following Chapters.

CHAP. I.

Of Simple Supporters of Combustion.

The term, *supporter of combustion*, is applied to those substances which must be present before combustible substances will burn. Thus *air* is a supporter of combustion, because a candle will not burn unless it be supplied with air. All supporters, not yet decompounded, are called *simple*.

We are at present acquainted with two simple supporters of combustion, namely, *oxygen* and *chlorine*.

SECT. I. *Of Oxygen.*

This substance is an *air*, or, as chemists use to call aërial bodies, a *gas*.* It was discovered by Dr Priestley, on the 1st of August 1774. It may be obtained by heating *black oxide of manganese* in an iron bottle fitted with a long iron tube. The extremity of the tube is plunged into a trough of water, having a shelf a little below the surface, on which stands an inverted glass cylinder full of water. The open mouth of this cylinder is brought over the extremity of the iron tube. As soon as the manganese is red hot, air issues from the extremity of the tube, and gradually fills the glass vessel, displacing the water. In this way any quantity of oxygen gas may be procured. Red lead, or red precipitate may be substituted for the manganese, but they do not yield so much oxygen. The salt called hyperoxymuriate of potash may also be used, and it yields a very great proportion of pure oxygen. Oxygen gas may also be obtained, by putting the manganese in powder into a glass retort, and pouring on it as much *sulphuric acid* as will make it into a thin paste. The heat of a lamp being applied to the retort while its beak is plunged into the water trough, the gas is disengaged in considerable quantity.*

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* The term *gas* is applied by chemists to all *airs* except *common air*.

This gas was called by its discoverer *dephlogisticated air;* Scheele, who likewise discovered it, called it *empyrial air;* Condorcet gave it the name of *vital air;* and at last Lavoisier, from an hypothesis respecting the formation of acids, distinguished it by the appellation of *oxygen gas*, which it now bears.

Oxygen gas possesses the mechanical properties of common air. It is colourless, invisible, and capable of indefinite expansion and compression.

Combustibles burn in it better and brighter than in common air. Animals can breathe it longer than common air without suffocation.

It has been ascertained, that one-fifth of the air of the atmosphere is oxygen gas, and that when this portion is abstracted, the air can neither support combustion nor animal life.

When substances are burnt in oxygen gas or air, or when animals breathe them, a portion of the oxygen always disappears, and, in some cases, even the whole of it.

Its specific gravity, according to Kirwan, is 1.103; according to Davy, 1.127; according to Fourcroy, Vauquelin, and Seguin, 1.087; according to Saussure, junior, 1.114, that of air being 1.000. At the temperature of 60°, and when the barometer stands at 30 inches, 100 cubic inches of common air weigh very nearly 30.5 grains troy. 100 cubic inches of oxygen in the same temperature and pressure, weigh, according to these results, 33. grains, 34.37 grains, 33.15 grains, and 33.97 grains troy.

It is not sensibly absorbed by water. 100 cubic inches of water freed from air by boiling, absorb 3.55 inches of this gas, according to the experiments of Dr Henry.

Oxygen is capable of combining with a great number of bodies, or it has an *affinity* for them, and forms compounds with them.

SECT. II. *Of Chlorine.*

This substance was first discovered by Scheele, and called by him *dephlogisticated muriatic acid.* Berthollet, who made many important experiments on it, and who conceived it to be a compound of muriatic acid and oxygen, gave it the name of *oxy-muriatic acid.*† Mr Davy has lately made it the subject of investigation, and has published some very important dissertations on it. He has shewn, by decisive experiments, that we have no proof of its containing oxygen. This has induced him to revive the original opinion of Scheele respecting its nature; and convinced of the propriety of the old names by which it was distinguished, and aware of the hazard of giving it a name from theoretical considerations, he has contrived the term *chlorine*, derived from the green colour, by which it may be distinguished from all other gaseous bodies.

Chlorine may be obtained by distilling a mixture of muriatic acid and the black oxide of manganese; or by mixing together three parts of common salt, and two parts of black oxide of manganese in a glass retort, and pouring over them two parts of diluted sulphuric acid. When this mixture is heated, a green coloured gas makes its appearance, which may be collected in glass phials over water. This gas is the substance in question.

This gas has a yellowish green colour, its odour is extremely offensive and suffocating, and it cannot be breathed. When drawn into the lungs mixed with common air it occasions a violent cough, which lasts for some time, accompanied with a sense of oppression and of weakness. It is capable of supporting combustion. Indeed, many substances, as phosphorus, antimony, &c. take fire in it of their own accord, without being kindled. Its specific gravity is 2.713, that of air being 1.000.

It is not altered by exposure to light, or to a red heat.

Water absorbs it slowly, and acquires a green colour, and the smell and properties of the gas. It may be frozen without losing the gas, but it is easily extricated by heat. When this liquid is exposed to the light, the chlorine disappears, oxygen gas escapes, and a portion of muriatic acid is found dissolved in the water.

Chlorine has the property of destroying vegetable blues, and other vegetable colours. This property has rendered it a valuable article in bleaching.

Oxygen has the property of combining with chlorine, and of forming with it a peculiar yellow coloured gas, hitherto not much examined. It was discovered by Mr Davy. To obtain it, the salt formed by passing a current of chlorine through a solution of carbonate of potash, a salt formerly distinguished by the name of hyper-oxymuriate of potash, is put into a flask, and diluted muriatic acid poured upon it. An effervescence takes place; and, by the cautious application of a very moderate heat, the combination in question comes over. Mr Davy proposes to distinguish this new gas by the name of euchloric gas, in consequence of the great intensity of its colour. Combustible substances do not act upon this gas so powerfully as upon chlorine. Indeed, the metals do not act upon it at all till it is decomposed. When exposed to a moderate heat, it is decomposed, and the expansion is accompanied by an explosion.

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* It is perhaps, most easily procured in large quantities from nitrat of potash, exposed to heat in an iron retort, as in the mode above stated for obtaining it from the black oxyd of manganese. This salt, by its decomposition affords as much as the manganese, and is to be obtained, where the latter is not perhaps known. Oxygen is also procured by exposing the leaves of vegetables under water, in a receiver exposed to the solar light; and also from the larger extremity of eggs; especially when fresh; for the air found in that situation, deteriorates, as the incubation of the egg advances. The action of galvanism on water, likewise affords it. COXE.

† Rather, oxygenated muriatic acid; it was subsequently contracted for the sake of convenience. COXE

As far as we know at present, chlorine, like oxygen, is a simple substance; and it is, in some respects, a more powerful supporter of combustion than oxygen itself.

Like oxygen, it has an affinity for a great number of bodies, and forms peculiar compounds by uniting with them.*

Chap. II.

Of Simple Combustibles.

By *combustible* is understood a substance capable of burning; and by *simple combustibles*, bodies of that nature not yet decomposed. They are five in number, namely, *hydrogen*, *carbon*, *phosphorus*, *sulphur*, and *boracium*. It is not impossible that the bases of all or most of these substances are metals; but the opinion has not yet been made out in a satisfactory manner.

Sect. I. *Of Hydrogen.*

Hydrogen, like oxygen, is a gas. It was first called *inflammable air*, and Mr Cavendish must be considered as its real discoverer.

It may be procured by putting some clean iron or zinc filings into a glass retort, and pouring over them sulphuric acid diluted with thrice its bulk of water. A violent boiling takes place, or, as chemists term it, an *effervescence;* gas issues abundantly from the beak of the retort, and may be received like the oxygen in glass vessels standing in a trough of water.

It is invisible and colourless, and possesses the mechanical properties of common air.

When prepared by the above process, it has a peculiar smell, ascribed at present to the presence of a little *oil*, formed by the action of the acid on the iron filings.

It is the lightest gaseous body known. Its specific gravity, according to Kirwan, is 0.0843; according to Lavoisier, 0.0756; according to Fourcroy, Vauquelin, and Seguin, 0.0887; according to Davy, 0.0744. According to these various estimates, 100 cubic inches, under the mean pressure and temperature, weigh 2.56 grains, 2.306 grains, 2.705 grains, and 2.27 grains Troy. It is about 13 times lighter than common air.

No combustible substance will burn in it; and no animal can breathe it for any length of time without death.

It burns when touched with a red hot iron, or when brought near a flaming taper. The colour of the flame is yellowish, and it gives but little light. If it be previously mixed with half its bulk of oxygen gas, it burns instantaneously, and with a loud explosion like the report of a pistol. If the mixture be put into a strong glass cylinder, standing over water, and kindled by an electric spark, the whole of the two gases disappears, and the cylinder is filled with the water. If the vessel be standing over mercury, or be hermetically sealed, its inner surface becomes coated with pure water. This water was found by Cavendish equal in weight to the two gases. Hence it has been inferred, that water is a compound of oxygen and hydrogen in the proportion of 7.5 by weight of oxygen to 1 of hydrogen.

When equal bulks of hydrogen and chlorine are mixed together in a glass vessel, no change takes place in the dark; but if the vessel be exposed to the sun, the mixture burns with an explosion. It burns also if an electric spark be passed through it. In both cases, the two gases disappear entirely; and there is found in their place a quantity of muriatic acid gas almost exactly equal to them in bulk. Now, the specific gravity of muriatic acid gas is almost exactly the mean of that of hydrogen and chlorine.—Hence the weight does not change sensibly. From this experiment it is inferred, that muriatic acid gas is a compound of chlorine and hydrogen, in the proportion of equal bulks of each in the gaseous state, or by weight of 97.24 chlorine
2.76 hydrogen
———
100.00

Hydrogen is not sensibly altered or absorbed by water. 100 cubic inches of water deprived of air absorb 1.53 inches of hydrogen, according to the experiments of Dr Henry.

Sect. II. *Of Carbon and Diamond.*

If a piece of wood be heated to redness in an iron bottle, or a crucible filled with sand, it is converted into a black brittle substance called *charcoal*; the properties of which are nearly the same from what wood soever it has been obtained, provided it has been exposed to a sufficiently strong heat.

Charcoal is insoluble in water, and not affected (provided air be excluded) by the most violent heat that can be applied.

It conducts electricity, is not liable to putrify, deprives meat of its putrid taste and smell, and is an excellent tooth powder.

It absorbs moisture with avidity, and likewise common air, oxygen, and hydrogen gas; but less of the last than of the two former.

When heated to 802°, it takes fire; and, if pure, burns all away without leaving any residuum. If the experiment be made in a glass vessel filled with oxygen gas, and the charcoal be heated by means of a burning-glass, the bulk of the oxygen gas is not altered, but a portion of it is converted into another gas, possessing quite different properties. It renders lime-water milky, and is quite absorbed by it, and cannot be breathed without occasioning instant death. This gas is called *carbonic acid.* It very nearly equals in weight the charcoal and the oxygen which have disappeared. Hence it is considered as a compound of them; and, from the proportion of each employed, it is considered as composed of very nearly 28 parts of charcoal, and 72 of oxygen.

When considerable quantities of charcoal are burnt in this manner, a portion of water also appears. Hence it is conceived, that charcoal contains a small portion of hydrogen. The constituent which constitutes by far the greatest part of it, is called *carbon*. This supposition is corroborated by the late experiments of Mr Davy. Carbon exists in two other states, namely, the diamond and plumbago.

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* This opinion of the nature of chlorine is not yet fully established; some most respectable chemists still maintain its compound nature. Coxe.

2. The diamond is a precious stone, transparent, and often crystallized in a six-sided prism, terminated by six-sided pyramids. It is the hardest of all bodies. Its specific gravity is about 2.3. It is a nonconductor of electricity.

When heated to the temperature of 14° of Wedgewood's pyrometer, or not so high as the melting point of silver, it gradually wastes away and burns. It combines with nearly the same quantity of oxygen, and forms the same proportion of carbonic acid as charcoal. Hence it consists chiefly of carbon. From the experiments of Davy, it has been inferred, that it contains a minute portion of oxygen as one of its constituents. The other constituent is carbon.

3. Plumbago, called also *black lead* and *graphite*, is well known as the substance of which pencils are made. It is dug out of the earth; it is of a dark blue colour, and has some metallic lustre; it is soft, brittle, and infusible. When heated to redness, it gradually wastes away, and is converted into carbonic acid, leaving a little iron behind. It seems a compound of pure carbon, with about one twentieth part of its weight of iron.

Neither charcoal, diamond, nor plumbago, provided they be pure, are affected by chlorine. They do not combine with it, and may be heated in it to whiteness, without undergoing any alteration.

Carbon combines with hydrogen, and forms a gas, formerly called heavy *inflammable air*, now carbureted hydrogen. Various gases were formerly called *heavy inflammable air*. The three following are the chief:

1. *Carbureted hydrogen*. It rises spontaneously in hot weather from stagnant water; it is evolved during the distillation of pitcoal; it is invisible, and possesses the mechanical properties of common air. Its specific gravity is 0.5554. One hundred cubic inches weigh 16.93 grains. For complete combustion, it requires twice its weight of oxygen. The products are its own bulk of carbonic acid and water. Hence its constituents are carbon and hydrogen. The following are the nearly the proportions:

28	hydrogen
72	carbon
100	

The gas obtained from pit-coal by distillation, consists chiefly of this gas.

Carbureted hydrogen gas burns with a yellow flame, and gives out a great deal of light.

2. When four parts of sulphuric acid, and one part of alcohol, are heated in a retort, a gas comes over called *olefiant gas*, or *super-carbureted hydrogen*. It is invisible; has a disagreeable smell; its specific gravity is 0.9745. It burns with a dense white flame, and great splendour, and requires thrice its bulk of oxygen for complete combustion. The products are water and twice its bulk of carbonic acid. Hence it has been concluded, that this gas is composed of

85	carbon
15	hydrogen
100	

When this gas is mixed with chlorine over water, the bulk of the mixture diminishes rapidly; and an opal coloured substance, like oil, swims upon the surface of the liquid. This substance seems to be a compound of the two gases. It dissolves in water, alcohol, and ether, and gives these liquids a hot and aromatic taste. It dissolves likewise in nitric acid without effervescence; but in sulphuric acid it effervesces, and chlorine is emitted.

3. *Carbonic oxide*. When a mixture of equal parts of iron filings and dry chalk is heated to redness in an iron retort, a gas comes over, partly carbonic acid and partly carbonic oxide. The former is washed away by means of lime water.

Carbonic oxide gas is invisible; its specific gravity is 0.956. It burns with a deep blue flame, and gives out but little light. For complete combustion, 100 measures of it require 40 of oxygen gas. The product is 92 measures of carbonic acid. As the carbonic acid produced is almost equal to the weight of the carboni oxide and oxygen consumed, it is presumed that there is no other product. Hence carbonic oxide is considered as a compound of carbon and oxygen in the following proportions:[*]

39	carbon
61	oxygen
100	

When equal bulks of this gas and chlorine gas are exposed to a strong light over mercury, they combine and form a gas just half the bulk of the constituents. It possesses acid properties. Water decomposes it; and muriatic acid and carbonic acid are obtained. This curious gas was discovered by Mr John Davy. Its specific gravity is 3.669; and 100 cubic inches of it weigh, under the mean pressure and temperature, 111.91 grains. It combines with four times its bulk of ammoniacal gas, and forms a neutral salt. Alcohol absorbs about 12 times its bulk of this gas without decomposing it. Mr John Davy has given this remarkable compound the name of *phosgen* gas, because it is formed by the action of light or its two constituents.[†]

Sect. III. *Of Phosphorus.*

Phosphorus may be obtained by pouring acetate of lead into urine, mixing the white powder which precipitates with charcoal, and distilling it in an earthen retort by means of a violent heat. The beak of the retort ought to be plunged under water. The phosphorus drops into the water like melted wax. It is usually obtained from burnt bones.

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[*] Since the different writers on the subject of carbonic oxyd, are not absolutely agreed as to the exact proportions of the substances entering into its composition; but speak of the carbonic acid, produced by its combustion, as "almost" and "nearly" equal to the carbonic oxyd and oxygen consumed; we may conclude the analysis to be as yet imperfect, and since it is combustible, it is quite as likely that other writers may be correct who regard hydrogen as a constituent of this gas. Coxe.

[†] This is too barbarous a name to be retained in Chemistry, even if farther experiments, verify the fact of its existence. It is evident the nomenclature of chemistry requires a revision; but it is very doubtful how far this should be left to the discretion of any single person. *Ibid.*

It was discovered in 1669, by Brandt, a chemist of Hamburgh; afterwards by Kunkel; and last of all by Boyle, who taught his operator, Godfrey Hankwitz, to make it; and he for several years was the only person that could make it.

Phosphorus, when pure, is semitransparent and yellowish, but when kept in water it becomes white and opake, and has some resemblance to white wax. It is soft, and may be easily cut with a knife. It is insoluble in water. Its specific gravity is 1.770.

It melts at the temperature of 99°. It cannot easily be melted in the open air without taking fire. If air be excluded, it evaporates at 219°, and boils at 554°

When exposed to the air, it emits a white smoke with the smell of garlic, and is luminous in the dark. This smoke is more abundant the higher the temperature, and is occasioned by the gradual combustion of the phosphorus. In oxygen gas it is not luminous unless the temperature be as high as 80°. Hence we learn, that it burns at a lower temperature in common air than in oxygen gas.* This slow combustion in the open air, renders it necessary to keep phosphorus in phials filled with water and well corked.†

When heated to 148°, it takes fire and burns with a vivid white flame, emitting a vast quantity of smoke. It leaves (if pure) no residuum, but the white smoke when collected is an *acid*, and is called *phosphoric acid*. If the combustion be conducted in a jar filled with oxygen gas, the oxygen will be found to diminish so much, that every 100 parts of phosphorus occasion the disappearing of 114 parts of oxygen. The acid formed weighs as much as the phosphorus and the oxygen which have disappeared. Hence it is considered as a compound of these two, in the proportion of 100 parts of phosphorus to 114 of oxygen.

Phosphorus is supposed capable of combining with a small portion of oxygen, and of forming a compound called *oxide of phosphorus*. It may be formed by putting a bit of phosphorus in a long glass tube, and exposing it to the heat of boiling water. It *sublimes* and lines the tube in fine white flakes. This substance is very combustible, and often takes fire of its own accord when exposed to the air.

When introduced into chlorine, phosphorus burns with a clear bluish white flame, and is converted into a solid white matter, which seems to consist of the two substances united. When this compound is placed in contact with water, it is converted into phosphoric acid and muriatic acid.

When phosphorus is melted by means of a burning glass in hydrogen gas, a portion of it is dissolved, and a new gas formed, first discovered by Gengembre, and called *phosphureted hydrogen gas*. It has a fetid odour like the smell of putrid fish. It burns spontaneously, when it comes into contact with common air or oxygen gas. Water dissolves a small portion of this gas, and acquires a bitter taste and unpleasant odour. The phosphorus gradually precipitates, and the hydrogen at the same time separates from the water. When kept in a glass jar, it soon loses its property of burning spontaneously.

From the experiments of Mr Davy, we learn, that when hydrogen gas is converted into phosphureted hydrogen, its bulk does not alter; and from the experiments of Mr Dalton, it follows, that the weight of 100 cubic inches of it under the common pressure, and at the temperature of 60°, is 26 grains. From these data, it is easy to establish its composition. Its constituents are obviously,

Phosphorus	91.23
Hydrogen	8.77
	100.00

Phosphorus combines with charcoal, and forms a compound of an orange red colour, called phosphuret of carbon. Common phosphorus contains a portion of this compound, which remains behind when the phosphorus is burnt. It is a light flocky powder, without taste or smell. When heated sufficiently, it burns, and the charcoal remains behind.

The compounds which phosphorus forms with the other bodies, are distinguished by the name of *phosphurets*.

Phosphorus is very poisonous when used internally. It has been recommended as a medicine, and said to be very efficacious in restoring the force of young persons exhausted by sensual indulgence.

SECT. IV. *Of Sulphur.*

Sulphur, distinguished also by the name of *brimstone*, has been known since the earliest ages.

It is a hard brittle substance, of a greenish yellow colour, without any smell, and with very little taste. It is a nonconductor of electricity, and becomes electric *negatively* by friction. Its specific gravity is 1.990. It is not altered by exposure to the air, nor is it soluble in water.

When heated to 170° it rises up in the form of a fine powder, which may be easily collected, and is called *flowers of sulphur*. It is then said to be *volatilized* or *sublimed*. It is obvious, from this property, that sulphur is a volatile substance.

When heated to about 218° it melts, becomes transparent, and looks like a brown coloured oil. At 560° it boils, and the vapour kindles as it exhales, and burns with a blue flame, and an extremely disagreeable smell. If it be set on fire, and plunged into a jar filled with oxygen gas, it burns with a strong violet flame. In both cases (provided the quantity of air or oxygen be sufficient) it burns away completely without leaving any residue. But if the fumes be collected, they are found to be an acid, which is known by the name of *sulphuric*

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* This is however explained, upon the property which the atmospheric nitrogen possesses of holding a small quantity of phosphorus in solution; but which oxygen gas is incapable of effecting. In this attenuated state, it is more readily combustible than in the solid form, and therefore appears luminous at an inferior temperature. COXE.

† A good mode of perserving phosphorus is by putting it into a weak solution of sulphat or nitrat of copper. The metal is reduced, and forms a solid and permanent coating; I have left it in this state for several weeks exposed to the air, with little or no change; and in case of the fracture of a vessel in which it may be kept, a security is thus acquired against its spontaneous inflammation in hot weather, should the accident remain undiscovered. *Ibid.*

acid. A portion of the oxygen disappears; and, from the experiments of Lavoisier, it follows, that the sulphuric acid formed is exactly equal in weight to the sulphur and the oxygen which have disappeared during the combustion.[*] Hence it is concluded, that this acid is composed of these two substances united together.

Many experiments have been made to ascertain the composition of sulphuric acid exactly. The following is the result which appears most accurate. It was obtained by Berzelius.

100	sulphur
150	oxygen
250	

But sulphur does not always combine with so great a portion of oxygen. It usually burns with a blue flame, and the suffocating vapours which it emits may be collected in glass cylinders filled with mercury, and standing in a trough containing mercury. They constitute a gas called *sulphurous acid.* It contains less oxygen than sulphuric acid, being compounded of

100	sulphur
100	oxygen
200	

When sulphur is kept melted in an open crucible, it becomes gradually thick and viscid. If it be now poured into water, it assumes a purple colour, and remains for some days soft; but it gradually becomes brittle, and of a light violet colour. Its texture is fibrous, and its specific gravity 2.325. In this state it has been called *oxide of sulphur,* from an opinion that it has combined with a little oxygen, and that this addition has altered its properties. But this opinion has not been proved experimentally.

When sulphur is dissolved in any liquid, as in a solution of potash, and then precipitated by an acid, it is always in the state of a white powder, known by the name of *lac sulphuris.*[†] This powder consists of sulphur combined with a little water. When the water is driven off by heat, the white colour of the sulphur disappears, and its natural yellow colour returns.

When a current of chlorine is made to pass through a quantity of flowers of sulphur, or when sulphur is heated in chlorine, it gradually disappears, and a beautiful red liquid appears in its place. Its specific gravity is 1.623. It smokes very strongly, has a strong smell, and is very volatile. It dissolves phosphorus readily. When mixed with water, it is decomposed, and a quantity of sulphur separates. This substance is obviously a compound of sulphur and chlorine. Water decomposes it; and, in that case, sulphuric and muriatic acids are formed.

Sulphur combines readily with hydrogen gas, and forms a gas known by the name of *sulphureted hydrogen,* which was first described by Scheele.

It may be formed by mixing together *potash* and sulphur, and boiling them together in a glass flask. When sulphuric acid is poured into the yellowish coloured liquid that is formed, an effervescence takes place, and the gas may be collected in proper vessels. It is obtained pure by digesting sulphuret of antimony in muriatic acid.

Sulphureted hydrogen gas is colourless, and possesses the mechanical properties of common air. It has a strong fetid smell, like that of rotten eggs. It neither supports combustion, nor animal life. Its specific gravity, according to Kirwan, is 1.106; according to Thenard, 1.231; according to Davy, 1.147. Water absorbs about its own weight of this gas, and acquires a fetid smell, a sweetish nauseous taste, and many of the properties peculiar to acids.

When this gas is set on fire, it burns with a reddish blue colour, and deposits a quantity of sulphur. When the electric spark is passed through it, sulphur is deposited, but the bulk of the gas is not altered. Sulphur is also deposited when *nitric acid* is dropt into water impregnated with it. When mixed with oxygen gas, and burnt, the only substances formed are sulphuric acid and water. Hence it is obvious, that its constituents are sulphur and hydrogen.

From the experiments of Mr Davy we learn, that when sulphur is heated in hydrogen gas, a portion of sulphureted hydrogen is formed, but the bulk of the gas is not altered. Hence the specific gravity of the gas obviously gives us the proportion of its constituents. It must consist of

Sulphur	93.5
Hydrogen	6.5
	100.0

Sulphur acts upon charcoal at a red heat. If a quantity of charcoal be put into a porcelain tube, and heated to redness, by passing it through a furnace, and sulphur be made to pass through it while in that state without any communication with the external air, a substance issues from the extremity of the tube, which may be obtained by means of a crooked glass tube luted to the porcelain tube, and plunged to the bottom of a glass vessel filled with water. This substance is a liquid, colourless and transparent when pure, but often tinged greenish yellow. Its taste is cooling and pungent, and its odour strong and peculiar. It does not dissolve in water. Its specific gravity is 1.3. In an exhausted receiver, or at the top of a barometrical tube, it assumes the gaseous form. It burns very easily, and detonates when mixed with oxygen gas and kindled. It was first discovered by Lampadius, and Clement and Desormes; and Berthollet, junior, investigated its properties. It is composed of sulphur and hydrogen, but contains more sulphur than sulphureted hydrogen. It may therefore be called *super-sulphureted hydrogen.*

Sulphur and phosphorus readily combine, and in various proportions; but the compound seems to be most intimate when the weights of the two ingredients are equal. The combinations may be made by mixing the two ingredients in a small phial and melting them together,

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[*] The imperfection of chemical analysis, is perhaps as strongly evinced by a reference to the investigations of the most experienced chemists on this very subject; thus, according to

	Sulphur.	Oxygen.
Lavoisier, sulphuric acid consists of	0.69	0.31
Berthollet	0.72	0.28
Thenard	55.56	44.44
Chenevix	51.50	38.50
Tromsdorff	70.00	30.00
Richter	42.05	57.95
Bucholz	42.05	57.95
Klaproth	42.03	57.07
Berzelius as above nearly . .	40.00	60.00

COXE.

[†] Sulphur precipitatum. *Ibid.*

or by cautiously heating them in a flask filled with water. But the first method is less hazardous; for the compound acts upon the water, and gases are formed, which sometimes occasion violent explosions. The compound has a yellowish green colour: it may be distilled over in a glass retort without decomposition. It has a tendency to the liquid form, which is greatest when equal proportions of the constituents are used. It then remains liquid in the temperature of 41°. When the sulphur predominates in this compound, it may be called *phosphuret of sulphur;* when the phosphorus, *sulphuret of phosphorus.* It is very combustible, and often takes fire spontaneously when exposed to the air.

From the experiments of Clayfield and Berthollet, junior, there is reason to conclude that sulphur contains a small quantity of hydrogen.

SECT. V. *Of Boracium.*

This substance was discovered by Mr Davy, but it was first described by Thenard and Gay Lussac. Mr Davy has lately published a more detailed account of its properties. To procure it, equal weights of the metal called *potassium* and dry *boracic acid* are to be put into a copper tube, and exposed for some minutes to a slight red heat. When cold, the mass is to be washed out with water, the potash saturated with muriatic acid, and the whole thrown upon a filter. An olive-coloured matter remains, which must be washed and dried. It is *boracium.*[*]

Boracium is of a dark olive colour, opake, brittle, its powder does not scratch glass, it is a non-conductor of electricity, and has some resemblance to charcoal. When heated to whiteness in a metallic vessel, it remains unaltered, provided common air or oxygen be excluded. After this process it sinks in strong sulphuric acid; but in its ordinary state it swims upon that liquid.

When heated in common air or oxygen gas, to a temperature not quite so high as 600°, it takes fire and burns with considerable brilliancy, somewhat like charcoal, and is converted into boracic acid. By this process, a portion of the oxygen disappears. Hence boracic acid is considered as a compound of boracium and oxygen. The exact proportion of the constituents of this acid have not yet been ascertained. According to Mr Davy's experiments, it is composed of one part boracium, and two parts oxygen; while Thenard and Gay Lussac consider it as a compound of two parts boracium and one of oxygen.

When placed in contact with chlorine, it burns spontaneously with a white light, and is partly converted into boracic acid, partly into a black matter which is considered as an *oxide of boracium.* It burns when slightly heated, and is converted into boracic acid. It decomposes sulphuric and nitric acids with the assistance of heat, and is converted into boracic acid. When melted with sulphur and kept long in contact with it, a kind of combination takes place as the sulphur acquires an olive colour. It does not combine with phosphorus. Whether it combines with hydrogen and with charcoal, has not been tried.

Potash and soda dissolve it both when liquid and when melted with it in a crucible, forming pale olive compounds, which give dark-coloured precipitates when treated with muriatic acid. It did not combine with mercury by heat.

Mr Davy has rendered it probable that it contains a little oxygen, and that, when deprived of this principle, it combines with metals, and forms compounds capable of conducting electricity.

Such are the properties of the simple combustible bodies; none of which, unless hydrogen be an exception, are, strictly speaking, simple substances, though we are not in possession of any accurate method of separating their constituents, and exhibiting them in a separate state. It is very likely that the hydrogen and oxygen separated from several of them, may be owing to the presence of water in them, from which it is very difficult to separate them completely.

Two of them, *boracium* and *carbon*, are solids which we are incapable of melting or altering by heat; two of them, sulphur and phosphorus, easily melt, and may be exhibited in a solid, liquid, or even gaseous state; while one of them, hydrogen, is always, when pure, in the state of a gas.

They all combine with oxygen, but in different proportions, as is obvious from the following table, exhibiting the quantity of oxygen capable of combining with 100 parts of each.

100 Hydrogen unites with	750 oxygen.
100 Carbon . .	251.6
100 Boracium . .	200
100 Sulphur . .	150
100 Phosphorus .	114

It has been supposed by some, that the affinity of different bodies for oxygen, is proportioned to the quantity of it with which they combine. According to this notion, the affinity of the simple combustibles for oxygen is in the order of the preceding table.

Chlorine has the property of combining with all the simple combustibles except carbon. With hydrogen[†] it forms muriatic acid; with sulphur, phosphorus, and boracium, it forms compounds not yet distinguished by specific names.

Hydrogen unites with all the simple combustibles, unless boracium be an exception. It is probable that they are all capable of combining with each other, at least, in one proportion, and some are known to combine in several. Chemists have agreed to give such compounds a name derived from one of the ingredients, and ending in *uret*, as *sulphuret of phosphorus*, *phosphuret of carbon.* When the compound is gaseous, the term is converted into an adjective, as *sulphureted hydrogen gas*, *carbureted hydrogen gas.*

CHAP. III.

Of Simple Incombustibles.

By simple incombustibles are meant all substances incapable of combustion which have not yet been decompounded. We are acquainted with only one body of that nature at present, namely, *azote.* There can be little doubt that it is a compound, though all attempts at a regular analysis of it have hitherto failed.

[†] This is by no means so firmly established, as to authorize so positive a conclusion; which, if true, will materially modify the science of chemistry. COXE.

[*] The French chemists have called it *bore.* *Boron* would be a better name than either.

Sect. I. *Of Azote.*

1. Azote, called also *nitrogen*, which was first particularly pointed out by Dr Rutherford in 1772, constitutes four-fifths of the atmosphere. The other fifth is oxygen. To obtain it pure, we have only to deprive any portion of air of the whole of its oxygen. This is easily done by confining in it for some time a mixture of sulphur and iron filings made up into a paste, or a quantity of phosphorus.

Dr. Priestley, who was one of the original experimenters on this substance, gave it the name of *phlogisticated air*. The French chemists called it at first *mofete*, and afterwards *azotic gas*, because animals cannot breath it without death. The name *azote*, though it has prevailed, is without doubt ill chosen.*

Azotic gas is invisible, and possesses the mechanical properties of common air. Its specific gravity, according to Kirwan, is 0.985; according to Lavoisier, 0.978; according to Biot and Arago, 0.969; that of common air being 1.000.

It neither supports flame nor animal life. Water does not sensibly absorb it. 100 cubic inches of water, freed from air by boiling, absorb about 1⅓ inches of this gas.

2. Though incombustible, it is capable of combining with oxygen gas.† When electric sparks are passed through a mixture of oxygen and azotic gases for some time, the bulk of the mixture diminishes, and an acid is formed. If the gases be mixed in the proper proportions, they disappear entirely, and are of course totally converted into an acid. This acid is the *nitrous*. Hence it follows, that nitrous acid is composed of oxygen and azote. This important discovery was made by Mr Cavendish. The result of his experiments gives us nitrous acid composed very nearly of

30 azote,
70 oxygen.
———
100

or one part azote united to 2⅓ of oxygen.

Nitric acid is a yellow‡ corrosive liquid, of great importance in chemistry. It acts with great energy on most other bodies, in consequence of the facility with which it parts with its oxygen. If copper or silver, for example, be put into it, the metals absorb oxygen and dissolve. The portion of acid which loses a part of its oxygen, assumes the gaseous form, and makes its escape out of the liquid, occasioning an effervescence. The gas which escapes is a compound of azote, and a smaller proportion of oxygen than exists in nitric acid. It is usually called *nitrous gas*. It has the curious property of combining with oxygen gas whenever it comes in contact with it, and of thus being again converted into nitric acid. The mixture becomes yellow; and, if standing over water, its bulk diminishes very much, because the water absorbs the acid as it forms.

If iron filings be kept for some days in a jar of nitrous gas, its bulk diminishes, and it loses the property of becoming yellow when mixed with common air. Its properties are now changed, and it is called *gaseous oxide of azote*.§ This new gas is composed of the same constituents as the former, but it contains a smaller proportion of oxygen. It supports combustion, and bodies burn in it almost with as much splendour as in oxygen gas.

Thus it appears, that azote has the property of combining with three different doses of oxygen.

3. As far as we know at present, chlorine has not the property of combining with azote.‖

4. The combinations of azote with the simple substances are not numerous, but some of them are important.

When putrid urine, wool, and many other animal substances, are distilled, among other products, there is obtained a substance of a pungent odour and taste, known by the names of *hartshorn*, *volatile alkali*, *ammonia*. It may be obtained pure, by heating a mixture of three parts of quicklime and one part of the salt called *sal ammoniac*, in a glass flask, and receiving the product over mercury. It is a gas. When electric sparks are passed through it, its bulk is doubled, and it is converted into a mixture of azotic and hydrogen gases. Hence it is a compound of these two substances. It consists of three parts by measure of hydrogen gas, and one part of azotic gas.

Azotic gas is said to have the property of dissolving a little charcoal, which it again deposits when allowed to stand over water.

It dissolves likewise a little phosphorus, and increases about one-fortieth part in bulk. When this phosphureted azotic gas is mixed with oxygen gas, it becomes luminous, in consequence of the combustion of the dissolved phosphorus.

Azotic gas is said likewise to dissolve a little sulphur when assisted by heat. Sulphureted azotic gas is said to resemble sulphureted hydrogen gas in its properties

Chap. IV.

Of Metals.

Metals, one of the most important classes of bodies. and to which we are indebted for most of our improvements, are very numerous. Indeed, the present state of chemical analysis leads to the opinion that all bodies will ultimately divide themselves into two sets; namely, *metals*, and supporters of combustion.

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* Mr. Chaptal long ago pointed out the impropriety of the term, and proposed that of nitrogen in its place; a term which is employed by many of the best chemical writers, and nearly as prevalent as that of Azote. If this latter term is continued, there is no doubt, that, conformably to the nomenclature employed, the nitrous and nitric acids should be called *azotous* and *azotic* acids. It is to be lamented, that different appellations should, in any case, be given to the same substance. Coxe.

† The capability of combining with oxygen is the chief character of combustibles in the antiphlogistic system; and there is reason to believe, that azote should be classed amongst the combustible bodies. Its not being accompanied with an emission of heat and light, in combining with oxygen, is not a sufficient reason for placing it amongst the incombustibles. *Ibid.*

‡ *Nitric* acid is not yellow; it is in its pure state perfectly devoid of any colour; it is the *nitrous* acid that is in this state; in other words, according to common opinion, *nitrous* acid is *nitric* acid, holding in solution various proportions of nitrous gas, to which the yellow colour is owing. *Ibid.*

§ More properly nitrous oxyd. Coxe.

‖ It has been stated, in the newspapers, that a very dangerous compound of azote and chlorine, has been formed by Mr Davy, and also in France; but the particulars have not, it is believed, reached this country. *Ibid.*

1. Metals are distinguished by a peculiar lustre, well known by the name of the *metallic lustre*. They are perfectly opake or impervious to light, even in the thinnest plates to which they can be reduced. The only exception is gold leaf. Its thickness does not exceed $\frac{1}{280000}$th part of an inch, and it allows the light to pass through it. If other metals could be reduced as thin, it is probable that they also would be pervious to light. They may all be melted when heated sufficiently. Some, as mercury, require very little heat to melt them; while others, as platinum, require a great deal. Their specific gravity is exceedingly various. All the old metals are at least five times heavier than water; and some, as platinum, more than twenty times heavier. But some of the new metals discovered by Davy are much lighter than water. They are the best conductors of electricity of all known bodies. None of them is very hard; but some of them may be hardened artificially, so as to exceed most other bodies. Their elasticity may likewise, in some cases, be artificially increased. Some of them are *malleable*, or may be extended by the blows of a hammer, while others are *brittle*. Some of them are *ductile*, or may be drawn out into wire, while others cannot. They differ considerably from each other in their *tenacity*, or in the weight which they are capable of supporting without breaking.

2. Several of them take fire when heated, and burn with considerable splendour, and almost all of them may be burnt by peculiar contrivances. After combustion, their appearance is totally changed: They have lost the metallic lustre, and are converted into earthy-like powders, formerly called *calces*, and now *oxides*. These oxides are of various colours, white, red, yellow, blue, &c. according to the metal, and several of them are employed as paints. Most metals are converted into oxides, merely by exposing them for a sufficient length of time to the action of heat and air, and all by the action of acids.

When these oxides are mixed with charcoal powder, and heated, they lose their earthy-like appearance, and are restored again to the metallic state. This process is called *reduction*. Some metallic oxides, as those of gold and silver, require only to be heated in order to be *reduced*;* but most of them require also the presence of charcoal, or of some other combustible substance. These oxides were at first considered as simple substances, and the metals were supposed to be composed of them and the principle of inflammability, called phlogiston. But it was shewn by the experiments of Lavoisier, that the oxides are compounds, and that they are composed of the metals from which they were obtained, united to oxygen. Thus, *oxide of gold* is a compound of gold and oxygen. It was the discovery of this fact that induced chemists to substitute the word *oxide* for calx.

Most metals are capable of combining with various doses of oxygen, and of forming various oxides, which it is of consequence to be able to distinguish. This may be done by prefixing to the term oxide the Greek ordinal numeral, expressing the peculiar oxide. Thus, *protoxide of tin* is the first oxide of tin, or tin combined with a minimum of oxygen. *Deutoxide of tin* is the second oxide of tin, or tin combined with two doses of oxygen. The terms *tritoxide*, *tetroxide*, *pentoxide*, &c. are to be understood in the same way. The last oxide of a metal is called *Peroxide*. *Peroxide* means a metal combined with as much oxygen as it can take up, or a metal saturated with oxygen †

3. Metals combine with the simple combustibles, and form compounds, many of which are of considerable importance. These compounds are denoted by a word formed from the simple combustible present, and terminating in *uret*. Thus, *sulphuret of tin* is a compound of sulphur and tin. In like manner, *carburet* and *phosphuret of iron*, means iron combined respectively with carbon and with phosphorus. Hydrogen gas dissolves some of the metals. These solutions are denoted by prefixing the metal converted into an adjective before the word hydrogen. Thus, *arsenical hydrogen gas* means a solution of arsenic in hydrogen gas. When hydrogen combines with a metal, and forms a solid compound, it is denoted by the term *hydroguret*.‡

4. The metals are not known to combine with simple incombustibles. But they combine with each other, and form a set of important compounds, called *alloys*. Thus *brass* is an *alloy* of copper and zinc; and *bell-metal* an *alloy* of copper and tin. When mercury is one of the metals combined, the compound is not called an alloy, but

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[*] Charcoal is not the only inflammable body by which metallic oxyds are capable of reduction. Dr Priestley accomplished it in hydrogen gas. The reduction of the oxyds of gold, &c. without any combustible being apparently present, is a strong point against the phlogistic doctrine. If, however, it should be proved, as is suspected, that azote, or nitrogen, is a compound of oxygen and hydrogen, it may be presumed, that in these, at present supposed, self reductions, the hydrogen of atmospheric azote, will be found to have an agency. Coxe.

[†] If we were absolutely certain as to the number of oxyds which each metal is capable of forming by union with oxygen, this mode of distinction would be sufficiently appropriate; as this is, however, a doubtful point, it requires consideration in its adoption; since, if intermediate oxyds of any of them, should be hereafter satisfactorily shewn to exist, we shall be under the necessity of altering any terms of the nature here proposed. Coxe.

[‡] It is extremely doubtful whether hydrogen combines with any metal: the gas is capable of holding some in solution; but when it forms such solid compounds as above stated, they are rather triple compounds of the metal and sulphureted hydrogen. And possibly this, if correct, may be ascribed to metals being already in combination with hydrogen; and hence, like substances saturated with oxygen, they can receive no more. By reference to the different metals under their respective sections, it will be perceived, that arsenic and tellurium only, are said by Davy, to combine with hydrogen. They combine with one or all of the other inflammable bodies, sulphur, phosphorus and carbon; and, with respect to the solid compounds, which are said by Davy to take place between hydrogen and tellurium and arsenic, the subject is not, as yet, sufficiently elucidated. I have ventured to assert, that hydrogen is equally essential to the acidification of bodies, with oxygen, the sole acidifying principle of the antiphlogistic theory; and it would be strongly in favour of such opinion, if it should be found, that those few metals which are capable of acidification, should be the only ones capable of forming hydrurets with hydrogen. *Ibid.*

an *amalgam*.[*] Thus, the amalgam of gold is gold dissolved in mercury.

5. The metals at present known (excluding the new ones discovered by Davy, which will be better described afterwards) amount to 27. They may be divided into the four following sets:

I. *Malleable.*

1. Gold.
2. Platinum.
3. Silver.
4. Mercury.
5. Palladium.
6. Rhodium.
7. Iridium.
8. Osmium
9. Copper.
10. Iron.
11. Nickel.
12. Tin.
13. Lead.
14. Zinc.

II. *Brittle, and easily Fused.*

1. Bismuth.
2. Antimony.
3. Tellurium.
4. Arsenic.

III. *Brittle, and difficultly Fused.*

1. Cobalt.
2. Manganese.
3. Chromium.
4. Molybdenum.
5. Uranium.
6. Tungsten.

IV. *Refractory.*

1. Titanium.
2. Columbium.
3. Cerium.

The fourth set consists of metals which have not hitherto been obtained in quantities, except in the state of oxides. Formerly the brittle metals were called *semi-metals*, and the malleable, *metals*. The first four malleable metals were once considered as *noble*, because their oxides may be reduced by mere heat.

SECT. I. *Of Gold.*

Gold seems to have been the first known of all the metals. As it occurs always in the metallic state, and is very soft and ductile, less skill would be necessary to work it.

1. Gold has a yellow colour, considerable lustre, and is destitute of taste or smell. It is very soft. Its specific gravity is 19.376, that of water being 1.000 It is the most ductile and malleable of all known bodies. It may be beaten out into leaves only $\frac{1}{280000}$th part of an inch in thickness, and drawn out into wire extremely fine. Its tenacity is considerable; a gold wire, 0.078 inch in diameter, being capable of supporting 150.07lbs. avoirdupois without breaking.

It melts at 32° Wedgewood, and, when melted, has a bluish green colour. It does not sensibly waste nor alter, though kept very long in the state of fusion. In very violent heats, however, it has been perceived to be partially volatilized. When carefully cooled after fusion, it sometimes crystallizes in four-sided pyramids. Gold is not altered by exposure to the air; it does not even lose its lustre.

2. It combines with oxygen, and forms different oxides, the number and properties of which are but imperfectly known. Two have been described. The first, or the purple, is formed when violent electrical explosions are passed through gold leaf, or when gold is subjected to combustion. It is probably a compound of 100 gold and 8 oxygen.

The second, or peroxide, is of a yellow colour. It may be obtained by dissolving gold in nitro-muriatic acid, and then precipitating the metal by means of lime-water. It falls in the state of this yellow oxide. When carefully washed and dried, it is insoluble in water, and tasteless. From an experiment of Proust, we may infer, that it is composed of 100 gold and 32 oxygen.[†]

It combines with chlorine, and forms the yellow-coloured, deliquescent, strong-tasted salt, at present distinguished by the name of *muriate of gold*.

3. Hitherto gold has been united with only one of the simple combustibles, namely, phosphorus. Hydrogen and charcoal are said to precipitate it from its solutions in the metallic state. With sulphur it does not combine. The action of boracium has not been tried.

The compound of phosphorus and gold is called *phosphuret of gold*. It may be formed by dropping small pieces of phosphorus into gold in fusion. It is brittle, whiter than gold, and contains $\frac{1}{24}$th of phosphorus. The phosphorus may be dissipated by exposing the compound to a sufficient heat.

4. As far as is known, gold does not combine with azote.

5. It combines readily with most of the metals, and forms a variety of alloys.

Gold is so soft, that it is seldom employed quite pure. It is almost always alloyed with a little copper or silver. Goldsmiths usually announce the purity of gold in the following manner. Pure gold is divided into 24 parts, called *carats*. Gold of 24 carats, means pure gold; gold of 23 carats, means 23 parts of gold alloyed with 1 part of some other metal; gold of 22 carats, 22 parts of gold alloyed with 2 parts of some other metal. The number of carats mentioned specifies the pure gold, and what that number wants of 24 indicates the quantity of alloy. The gold coin of this country, or *sterling* gold, as it is called, is gold of 22 carats. Jewellers' gold is gold of 18 carats.

SECT. II. *Of Platinum.*

Platinum, which approaches to gold in many of its properties, was unknown in Europe as a peculiar metal till 1749. Hitherto it has been found only in South America, in St Domingo, and in the silver mine of Guadalcanal in Spain. For the first accurate investigation of its properties, we are indebted to Dr Lewis; and since his time it has been investigated by a great number of very eminent chemists.

It is brought from America in small flat grains, having a silvery lustre. These grains, besides platinum, contain no less than eight other metals. The platinum may be obtained pure, by dissolving the grains in nitro-muriatic acid, and pouring a solution of *sal ammoniac* into the liquid. An orange yellow precipitate falls. This precipitate is to be washed and dried, and exposed to a red heat. The powder which remains is pure platinum. It may be amalgamated with mercury; and, by cautious heating and hammering, it may be reduced into an ingot.*

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[*] Why is it necessary to preserve the old term of amalgam? Alloy, as applied to the union of metallic bodies, is equally applicable to their combinations with mercury; and a term, at least, unnecessary, may be discarded from further use. COXE.

[†] Mr Davy says, "no dependance can be placed on the statements of chemists, relative to pure oxides of gold:" by his experience they are triple compounds. COXE.

1. Platinum has a white colour like silver, but not so bright. It is as hard as iron. Its specific gravity, when hammered, is at least 23, so that it is the heaviest of all known bodies. It is very ductile and malleable. A platinum wire of the diameter 0.078 inch, is capable of supporting 274.31 lbs avoirdupois, without breaking. It is very difficult of fusion, and indeed cannot be melted in any quantity by the greatest heat which we can produce.† But at a white heat, pieces of platinum may be welded together like pieces of hot iron. It is not altered by the action of heat and air.

2. Platinum cannot be converted into an oxide by the action of heat and air; we must have recourse to the action of acids. There are two oxides of platinum known: the protoxide is green, the peroxide brown.

The peroxide may be obtained by pouring lime water into the solution of platinum in nitro-muriatic acid. The brown powder which precipitates is to be dissolved in nitric acid, the solution evaporated to dryness, and the acid driven off by a cautious application of heat. The brown powder which remains is the peroxide. It is tasteless, insoluble in water, and decomposed by a red heat. It is composed, according to Mr Chenevix's experiments, of

87 platinum,
13 oxygen.
100

If the peroxide is gradually heated, it assumes a green colour, owing to the separation of a quantity of oxygen. This green powder is the protoxide, composed of

93 platinum,
7 oxygen.
100

Chlorine combines with platinum, and forms the dark brown substance distinguished by the name of muriate of platinum.

3. The simple combustibles have but little action on platinum. Neither hydrogen nor carbon unites with it. Phosphorus combines readily, and forms a *phosphuret*. It may be obtained by projecting phosphorus on red hot platinum. Its colour is silver white; it is very brittle and hard, and easily melts. The phosphorus may be driven off by heat. Platinum cannot be made to unite with sulphur. In this respect it resembles gold.

4. Azote does not combine with platinum.

5. It combines with most of the other metals, and forms alloys, first examined by Dr Lewis.

Gold unites to it, but a strong heat is necessary to combine them uniformly. Platinum alters the colour of gold very much. An alloy of four parts of gold and one of platinum has the colour of pure platinum. The colour is much affected unless the platinum be less than $\frac{1}{17}$th of the gold. If such an alloy be digested in nitric acid, the platinum is dissolved. Thus it is easy to detect any attempt to debase gold by the addition of platinum.

SECT. III. *Of Silver.*

Silver seems to have been known almost as early as gold.

1. It has a fine white colour, with a shade of yellow, and is remarkably brilliant when polished. It is rather harder than gold. Its specific gravity is about 10.510. In malleability and ductility, it is inferior to none of the metals except gold. It may be hammered out into plates not more than $\frac{1}{100000}$th of an inch thick, and drawn out into wire finer than a human hair. A silver wire 0.078 inch thick, is capable of supporting 187.13lbs. avoirdupois, without breaking. It melts when thoroughly red hot, or at the temperature of 22° Wedgewood. By a very violent heat it may be boiled, and partly volatilized. When cooled slowly, it crystallizes in four-sided pyramids.

2. By very long exposure to heat and air, silver may be oxidized; but the process is so tedious and difficult, that we cannot have recourse to it. There are two oxides of silver known, both of which have an olive green colour.

The peroxide may be formed by dissolving silver in nitric acid, and precipitating, by means of lime water. The powder which falls, when washed and dried, is the peroxide. It is tasteless and insoluble in water. When exposed to light or to heat, it is decomposed, and the silver reduced. It is composed of about

92.67 silver,
7.33 oxygen.
100

The protoxide may be formed by heating the solution of silver in nitric acid, in contact with a quantity of granular silver. It resembles the peroxide in colour, but its combination with nitric acid is more soluble.

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* By the method mentioned in the text, platinum can only be obtained in small quantities. Whereas Dr Bollman has succeeded in rendering the orange-yellow precipitate malleable in quantities of three and four pounds, by a process, in which neither mercury, arsenic, or any flux is necessary. The doctor exhibited to the American Philosophical Society a distillatory vessel weighing 700 oz.; its capacity was twenty-five gallons. Crucibles, evaporating capsules, points for lightning rods, blowpipe and other spoons, are manufactured of it in Philadelphia, with the same facility as with silver. We have seen a cast-iron pot for the use of the laboratory, which had a thick plate of platinum perfectly welded to its inner surface. The doctor also welds platinum to both surfaces of sheet-iron, and then has them rolled to any dimensions. He is now endeavouring to unite platinum to the surfaces of copper without soldering; with the view of substituting it for the noxious bell-metal articles, which have been too long retained in culinary use. As we are perfectly acquainted with the doctor's process, we can vouch for his platinum being as pure as our present knowledge of chemistry can produce it; and so far from being as hard as iron, as usually stated by European writers, it is as soft and malleable as pure silver: but may be considerably hardened by hammering. HEMBEL, jun.

† It is readily melted by the action of a powerful Galvanic battery. COXE.

Chlorine combines with silver, and forms with it the white-coloured, insoluble, and tasteless substance, at present distinguished by the name of muriate of silver.

3. Neither hydrogen nor carbon have been combined with silver; but it combines readily with sulphur and phosphorus.

When thin plates of silver and sulphur are laid alternately in a crucible, they melt by a moderate heat, and form sulphuret of silver. This compound is found in silver mines, or it exists *native*, as mineralogists term it. It has a dark grey colour, a metallic lustre, and the softness, flexibility, and malleability of lead. Its specific gravity is 7.2 It is composed of 87.27 silver, and 12.73 sulphur. When silver plate is long exposed, it contracts a thin covering of this substance. Hence the tarnish of silver is owing to its combining with sulphur.

Phosphuret of silver may be formed by projecting phosphorus into melted silver. It is white, composed of grains, breaks under the hammer, but may be cut with a knife. It is composed of four parts of silver and one of phosphorus. Heat decomposes it, by dissipating the phosphorus.

4. Silver does not combine with azote.

5. It combines readily with most of the metals.

When gold and silver are melted together, they combine spontaneously, in the proportion of one part of silver and five of gold. They may, however, be melted together, and mixed in any proportion whatever. This alloy is harder and more sonorous than pure gold. Its hardness is a maximum when the alloy consists of two parts gold and one silver. The density of the alloy is a little diminished, and the colour of the gold is much altered, even when the proportion of silver is small. It is not only pale, but has a very sensible greenish tinge.

Silver and platinum may be combined by fusion, and form a hard alloy, not so ductile as silver. The two metals separate when the alloy is kept in fusion. Hence there appears but little affinity between them.

SECT. IV. *Of Mercury.*

Mercury, called also *quicksilver*, was known to the ancients, and applied by them to the same purposes as it is by the moderns.

1. Its colour is white, like that of silver; it has a good deal of lustre, and is destitute of taste and smell. Its specific gravity is 13.568. At the common temperature of the atmosphere, it is always in a state of fluidity. But if it be cooled down to 39° below zero, it becomes solid like any other metal. The congelation of mercury by cold was accidentally discovered by Professor Braun, at Petersburgh, in 1759. The freezing point was ascertained by Mr Hutchins, at Hudson's Bay, in consequence of the directions of Mr Cavendish. Solid mercury is malleable; but neither the degree of its malleability nor its ductility have been ascertained by experiment. Mercury boils when heated to 656°. Its vapour is invisible and elastic like air. It may be easily distilled over in proper vessels, and by this means is obtained pure.

2. Mercury is not altered by being kept in water. But when long agitated in air, or when kept heated in the open air, it gradually loses its metallic appearance, and is oxidized. Only two oxides of mercury have been yet ascertained in a satisfactory manner, the *protoxide*, which is *black*, and the *peroxide*, which is *red*.

The protoxide is a black powder, which may be obtained by agitating mercury for a long time in a stout phial; or by heating the salt called *calomel*, or *muriate of mercury*, with a solution of potash. It is black, insoluble in water, and contains about 5 per cent. of oxygen.

The red oxide, called also *red precipitate*, may be obtained by keeping mercury for several days, nearly at the boiling point, in a tall glass vessel, so contrived as to prevent the evaporation of the mercury, and admit a communication between the interior of the vessel and the atmosphere. The mercury becomes at first black,* and gradually changes to red. It may be formed more speedily and easily by dissolving mercury in nitric acid, evaporating the solution to dryness, and heating the dry salt gradually, almost to redness, in a crucible or capsule. Nitric acid fumes exhale, and the whole assume a fine red colour. The red oxide of mercury has an acrid and disagreeable taste, acts as an escharotic, and possesses poisonous qualities. When heated with zinc or tin filings, it sets them on fire. It contains about 10 per cent. of oxygen. When heated it gives out oxygen gas, and the mercury is reduced.

3. Mercury does not combine with hydrogen or carbon; but unites readily with sulphur and phosphorus.

When two parts of sulphur and one of mercury are triturated together in a mortar, they gradually assume the appearance of a black powder, formerly called *æthiops mineral*. The same compound is formed by adding mercury slowly to its own weight of melted sulphur. When formed by the first process, the powder is black, but a microscope detects in it small globules of mercury; when formed by the second process, the powder is black, with a shade of purple. This compound has been ascertained to consist of mercury and sulphur united together, in what proportion is not well known.

When this black sulphuret is exposed to a red heat in a glass vessel, it sublimes and forms a cake of a fine scarlet colour. In this state it is usually called *cinnabar*, and when reduced to a fine powder, *vermilion*.† It is well known as a red paint. Its specific gravity is about 10. It is tasteless, insoluble in water and in muriatic acid. When suddenly heated it burns with a blue flame. When mixed with iron filings, and distilled, it is decomposed, and running mercury obtained in the receiver. It is composed of about 85 parts mercury and 15 sulphur.

When phosphorus is mixed with the black oxide of mercury, and exposed to heat, the mixture readily combines, forming a black mass, which seems to be phosphureted oxide of mercury. At least phosphorus and mercury do not unite when heated together.

4. Mercury does not unite with azote.

5. It combines with most metals, and forms compounds called *amalgams*.

The amalgam of gold is formed very readily by throwing small pieces of red hot gold into hot mercury. The two metals combine in any proportion. The amalgam is white and fluid if the mercury exceed. But by squeezing it through leather, the excess of mercury separates, and a solid amalgam remains, of the consistence of butter, which gradually crystallizes. It consists of one part of mercury to two of gold. This amalgam is much used in gilding.

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* Might it not expedite the process, by employing at once the black oxyd, formed from calomel; several days of continued exposure to heat would probably thereby be saved. COXE.

† The mode by which the Chinese form their vermilion, so far superior to the Dutch and English, is, I believe, unknown. By digesting the English vermilion repeatedly in fresh portions of urine, I have made it nearly equal in appearance to the Chinese. How the urine acts I cannot say. *Ibid.*

The amalgam of platinum may be formed by triturating the powder of platinum with mercury, adding gradually a portion of either ingredient, till the combination is completed. When the process of amalgamation is once begun, it goes on easily. This amalgam has the consistence of butter, a white colour, much lustre, and does not tarnish by keeping. The mercury may be driven off by heat.

The amalgam of silver may be made in the same manner as that of gold, and with equal ease. It has a white colour, is always soft, and crystallizes.

All these amalgams are decomposed, and the mercury driven off by heat.

SECT. V. *Of Palladium.*

This metal was lately discovered by Dr Wollaston, in crude platina.* Mr Chenevix announced soon after that he had succeeded in forming this metal artificially, by combining together platinum and mercury; but as nobody has been able to repeat his experiment with success, we must suppose him mistaken.

To obtain palladium, dissolve a sufficient quantity of crude platina in nitro-muriatic acid, and pour a solution of the salt called *prussiate of mercury* into the liquid. A yellowish white powder falls. When this powder is washed and dried, and exposed to a red heat, it leaves a white matter, which is *palladium*. When strongly heated with sulphur and borax, it may be melted into a button.

1. Palladium thus obtained is a white metal, very like platinum in its appearance. Its specific gravity, when hammered, is 11.871. It is as malleable as platinum, breaks with a fibrous fracture, and appears of a crystallized texture. It is not altered by exposure to the air, and a very violent heat is necessary to fuse it.

2. When kept strongly heated, its surface acquires a blue colour. This is supposed a commencement of oxydizement. A more violent heat makes it resume the original metallic appearance. Sulphuric, nitric, and muriatic acids dissolve a portion of it when assisted by heat, and assume each a red colour. Nitro-muriatic acid is the best solvent of it.

3. Neither hydrogen nor carbon combine with this metal. But when brought into contact with sulphur while red hot, it melts immediately, and the sulphuret formed continues in fusion till only obscurely red. It is rather paler than the pure metal, and very brittle.

4. The simple incombustibles do not combine with palladium; but it unites with the metals, and forms alloys, which have been examined and described by Mr Chenevix.

SECT. VI. *Of Rhodium.*

This metal exists also in crude platina, and was discovered by Dr Wollaston still more recently than the last.

The process followed by Dr Wollaston for obtaining it, is somewhat complicated. Crude platina is dissolved in nitro-muriatic acid, and the platinum precipitated by sal ammoniac. A piece of clean zinc is immersed into the residuary solution, which throws down a black powder. This black powder is digested with dilute nitric acid in a very gentle heat, to dissolve some copper and lead with which it is frequently contaminated. It is then dissolved in nitro-muriatic acid, common salt is added to the solution, and the whole is gently evaporated to dryness. The residuum is washed repeatedly with small quantities of alcohol, which dissolves two salts, consisting of the oxides of platinum and palladium, in combination with common salt. There remains behind a deep red-coloured substance, consisting of the oxide of rhodium united to common salt. By solution in water, and gradual evaporation, rhomboidal crystals of a deep red colour are obtained. These crystals being dissolved in water, and a plate of zinc immersed into the solution, a black powder precipitates, which being strongly heated with borax, becomes white, and assumes a metallic lustre. In this state it is *rhodium*.

1. Rhodium thus obtained is white. Its specific gravity exceeds 11. No degree of heat hitherto applied is sufficient to melt it. Of course its malleability and other similar properties are unknown.

2. It is not oxidized by exposure to heat and air. Neither is it much acted on by acids. The only oxide of rhodium known is of a yellow colour. It may be obtained by dissolving the red crystals mentioned above, and precipitating by means of potash. This oxide, when dissolved in nitric or muriatic acid, does not crystallize.

3. It unites readily with sulphur, and by that means is easily melted. When the sulphur is driven off by heat, the metallic button obtained is not malleable. The action of the other simple combustibles is not known.

4. It does not combine with the simple incombustibles. It forms alloys with all the metals tried by Dr Wollaston, except mercury, with which it does not combine. It does not, like platinum and palladium, destroy the colour of gold when alloyed with it.

SECT. VII. *Of Iridium.*

This metal was discovered by Mr Smithson Tennant, in 1803. Attempts were made by Descostils, and by Fourcroy and Vauquelin soon after, to obtain the same metal, but they succeeded but imperfectly.

When crude platina is dissolved in nitro-muriatic acid, a black powder remains, which preceding chemists considered as plumbago, but which Mr Tennant ascertained to be a compound of two new metals. When kept for some time in a red heat, mixed with its own weight of potash in a platinum crucible, water poured on the mixture forms a deep orange-coloured solution. Muriatic acid being digested on the powder which remains, becomes first blue, then green, and at last deep red. By repeated fusions with potash, and digestions in muriatic acid, the whole of the black powder is decomposed and dissolved. The potash solution contains the metal called *osmium;* the muriatic acid solution the metal called *iridium.*

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* This metal has also been obtained from certain portions of gold from Brazil, by Mr Cloud, of the United States' Mint. COXE.

A piece of zinc being put into this last solution, precipitates a black powder; when heated it becomes white, and is *iridium.*

1. It has the appearance of platinum, and seems as difficult of fusion as that metal. It resists the action of acids, even the nitro-muriatic, almost completely.

2. Its affinity for oxygen seems weak; but, like other metallic bodies, it unites with that principle. The change of colour which its solution in muriatic acid assumes, seems to prove that it is capable of combining with different dozes of oxygen. When the colour is *blue*, the metal seems oxidized to a minimum; when *red*, it seems oxidized to a maximum.

3. The simple combustibles do not seem to combine with iridium. Mr Tennant did not succeed in his attempt to unite it with sulphur.

4. It formed alloys with all the metals tried except arsenic. It does not alter the colour of gold, and cannot be separated from gold and silver by cupellation.

SECT. VIII. *Of Osmium.*

This metal was discovered by Mr Tennant at the same time with the preceding. It exists in the black powder separated during the solution of crude platina, and may be obtained in solution in potash, by the process described in the last Section. When sulphuric acid is mixed with this solution, and the whole subjected to distillation, a colourless liquid comes over, consisting of water, holding the oxide of osmium in solution. It has a peculiar smell. Hence the name *osmium*, applied to the metal. When mercury is agitated in this solution, the osmium combines with it, and leaves the water, and by applying heat, the mercury is driven off, and the metal obtained in a state of purity.

1. Osmium has a dark grey or blue colour, and the metallic lustre. In the open air it is easily dissipated by heat; but in close vessels, it resists any degree of heat without alteration. It is not acted on by any acid, not even the nitro-muriatic, but is easily obtained in solution by the action of potash.

2. Osmium is easily oxidized by heat in the open air. The oxide has a peculiar smell, and a kind of oily appearance. It is volatile and soluble in water. The solution is colourless, does not alter vegetable blues, and strikes first a purple, then a blue, with the infusion of nut-galls.

3. The action of the simple combustibles on this metal is not yet known. Neither do we know much of its combination with other metals. It amalgamates with mercury, and Mr Tennant united it by fusion with copper and gold.

SECT. IX. *Of Copper.*

Copper seems to have been known as early as any metal except gold and silver. It was very much employed by the ancients before the method of manufacturing steel became familiar.

1. Copper has a fine red colour, but it soon tarnishes when exposed to the air. Its taste is styptic and nauseous, and when rubbed it emits a disagreeable odour. It is very poisonous when taken internally. It is softer than iron, but harder than gold. Its specific gravity, when pure, is about 8.9. Its malleability and ductility are very considerable. A copper wire 0.078 inch in diameter is capable of supporting 302.2 lbs. avoirdupoi without breaking. It melts at 27° Wedgewood, and gradually evaporates in visible fumes. When melted, it has a bluish green colour, something like that of melted gold. When allowed to cool slowly, it crystallize in quadrangular pyramids.

2. It is not altered though kept under water. When heated in contact with air, it is gradually converted into a black oxide by the combination of oxygen. Before a blow-pipe of oxygen and hydrogen gases, it burns with a fine green flame. There are two oxides of copper. The protoxide is found naturally of a red colour, but when formed artificially it is orange. The peroxide is black.

The protoxide was first recognised by Mr Proust. It may be prepared by heating together a mixture of equal parts of black oxide and copper in powder in muriatic acid. Almost the whole is dissolved, and the solution is colourless. By pouring potash into the solution, the protoxide precipitates in the state of a yellow powder. This oxide is composed of 88.89 parts copper, and 11.11 oxygen. It attracts oxygen with such avidity, that it can scarcely be dried without becoming black.

The peroxide of copper is easily formed by keeping copper filings a sufficient time red hot. It contains 8 parts copper, and 20 oxygen. It is black. It combines with water, and forms a blue-coloured matter called *hydrate of copper.*

3. Copper has not been combined with hydrogen or carbon; but it unites with sulphur and phosphorus, forming the *sulphuret* and *phosphuret of copper.*

When equal parts of sulphur and copper are stratified in a crucible, they combine at a red heat, and form sulphuret of copper, of a very deep blue colour. It is brittle, and composed of 78 copper and 22 sulphur. If copper filings and sulphur in powder be mixed, and gradually heated in a flask, they combine before they are heated to redness; but at the instant of combination, a quantity of heat is evolved sufficient to convert the sulphuret into a glowing red, as if in a state of vivid combustion.

Sulphuret of copper is capable of combining with an additional dose of sulphur, and forming a *super-sulphuret.* It is brittle, has a yellow colour, and the metallic lustre. It is found native, and known under the name of *copper pyrites.*

Phosphuret of copper may be formed by projecting phosphorus on red hot copper. It is white, tough, but not ductile, hard, and contains the 5th of its weight of phosphorus. When repeatedly melted, it still retains about 1-12th of its weight of phosphorus, and then has much the appearance of steel, and admits of an equally fine polish.

4. Copper does not combine with azote.

5. It combines with most of the metals, and some of its alloys are of considerable importance.

Copper unites readily with gold, and even heightens the colour, while it increases the hardness, and does not injure the ductility. Gold coin consists of gold alloyed with copper or silver, or with both. Our coin contains 1-12th of alloy, usually both silver and copper. A pound of standard gold is coined into 44½ guineas.

Platinum combines with copper, but a violent heat is necessary. The alloy is white, hard, ductile, takes a fine polish, and is not liable to tarnish. Hence it has been proposed for the mirrors of telescopes.

Copper and silver easily unite by fusion. The alloy is harder and more sonorous than silver, and retains its white colour even when the proportion of copper is considerable. Our silver coin consists of 12⅓ silver, alloyed with one of copper. A pound of standard silver is coined into 62 shillings.

Copper may be united to mercury by pouring a small stream of it melted into mercury, heated nearly to the boiling point; or by keeping plates of copper in a solution of mercury in nitric acid. It is white, and at first soft, but gradually hardens when exposed to the air.

SECT. X. *Of Iron.*

Iron was not known at so early a period as gold, silver, and copper. The art of working it was discovered in the East, and first communicated to the Greeks by the Phrygians, from whom it gradually made its way through the rest of Europe.

1. Iron has a bluish white colour, a styptic taste, and emits a smell when rubbed. It is one of the hardest of the metals. Its specific gravity varies from 7.6 to 7.8. It is attracted by the magnet or loadstone, and is itself the substance which constitutes the loadstone. When iron is perfectly pure, it retains the magnetic virtue but a short time.

It is malleable in every temperature, and its malleability increases with the temperature. It cannot be hammered into so thin plates as gold or silver. But it may be drawn out into very fine wire. An iron wire of 0.078 inch in diameter is capable of supporting 549.25 lbs. avoirdupois without breaking. When heated to 158° Wedgewood, it melts; a temperature so high, that it is difficult to go much beyond it.

2. It is much more easily converted into oxide than any of the metals described in the preceding Sections. When left exposed to the air, especially in a moist place, it is soon converted to a red or yellow powder, called *rust*, which is nothing else than an *oxide* of iron usually combined with carbonic acid. When kept under water, especially in warm weather, it is gradually converted into a black brittle matter, which is also an oxide, while some hydrogen gas is disengaged, owing to the decomposition of the water. If vapour of water be passed through red hot iron, the iron is rapidly oxidized and much hydrogen gas is obtained. If an iron wire, having a small bit of lighted cotton at its extremity, be plunged into a jar of oxygen gas, it burns with great brilliancy, and is converted into the same black oxide, which falls to the bottom of the jar in melted drops.

There are two oxides of iron, which have been ascertained in a satisfactory manner. The *black* oxide may be obtained, by keeping iron filings a sufficient time in water, by making steam pass through iron filings at a red heat, by burning iron wire in oxygen gas, or by dissolving iron in diluted sulphuric acid, and dropping potash into the solution. It is a black powder, insoluble in water, is attracted by the magnet, and has a good deal of metallic lustre. It is a compound of 78.5 parts iron and 21.5 oxygen.

The *red oxide*, or *peroxide*, may be obtained, by keeping iron filings red hot in an open vessel, and agitating them constantly till they are converted into a red powder; or by exposing a solution of iron in sulphuric acid for a long time to the atmosphere, and then precipitating by means of potash. It is a red powder, insoluble in water, and constitutes the base of several of the common red paints. Clay and bricks owe to it their yellow and red colours. It is composed of 69 iron and 31 oxygen.

3. Iron seems capable of combining with all the simple combustibles. Hydrogen, indeed, has never been united to it in a solid state, but hydrogen gas dissolves a little iron, which it gradually deposits when kept over water.

Carburet of iron is found native, and is the substance mentioned in a preceding Section under the name of *plumbago*, or *black lead*. It is a soft substance, of a dark blue colour, a granular texture, and the metallic lustre. It does not burn with a flame, but gradually wastes away when kept red hot. When thrown into melted nitre, a very splendid combustion is produced. Its nature was first developed by Dr Lewis, and afterwards more fully explained by Scheele and the French chemists. It seems to consist of about 19 parts of carbon, and one of iron.

Phosphuret of iron may be formed by dropping bits of phosphorus upon red hot iron. Its colour is dark steel grey, it is very brittle, and does not easily dissolve in acids. It exists in different ores of iron, and is considered as giving to the variety of iron, called *cold short iron*, the property of being brittle while cold, though it be malleable while hot. Phosphuret of iron was at first considered by Bergman as a peculiar metal, and called *siderum*.

Sulphuret of iron may be formed, by melting together in a crucible equal parts of iron filings and flowers of sulphur. It is of a black or very deep grey colour, brittle, and very hard. When the two constituents of it combine, a great quantity of heat is evolved, which makes the whole strongly red hot. This sulphuret is composed of 63 iron and 37 sulphur. It exists native, and is known by the name of *magnetic pyrites*. Its colour is that of bronze; it has the metallic lustre, but its powder is blackish grey. Its specific gravity is 4.518. It strikes fire with steel, and easily melts when heated. It is not only magnetic, but is itself capable of being converted into a permanent magnet, as Mr Hatchett discovered.

Iron is capable of combining with a still greater proportion of sulphur, and of forming a compound which may be called *super-sulphuret of iron*. It occurs native in great abundance, and is known by the name of *pyrites*, or *iron pyrites*. It is yellow, has the metallic lustre, is brittle, strikes fire with steel, and is often crystallized in cubes.* Its specific gravity is 4.5. When distilled, it loses its excess of sulphur, and is converted into common sulphuret of iron. By this process, sulphur is sometimes obtained for the purposes of manufactures. Pyrites is composed of 80 common sulphuret of iron and 20 sulphur, or more exactly of about 47 iron and 53 sulphur. The super-sulphuret is not magnetic, nor susceptible of becoming a magnet. Mr Hatchett found, that phosphuret of iron is also capable of magnetic impregnation; and it is well known that iron containing a portion of carbon, or *steel*, possesses the same property in perfection. Hence Mr Hatchett concludes, that permanent magnets consist of iron, combined with a certain proportion of a simple combustible. But, when saturated with simple combustibles, it loses its magnetic properties entirely. This is known with respect to iron saturated with sulphur and carbon, and is probable with respect to iron saturated with phosphorus. The subject requires and deserves farther investigation.

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* This variety is found in Virginia of a very large size, often to the extent of nearly 1½ inch. COXE.

There are a great many varieties of iron, which artists distinguish by different names; but they may be all reduced under the following classes: *Cast iron*, *wrought* or *soft iron*, and *steel*.

Cast iron, or *pig iron*, is the name of the metal when first extracted from its ores. The ores of iron commonly used, are a mixture of the oxide of the metal and clay. They are reduced to small pieces, and exposed to a violent heat, mixed with charcoal and lime. The charcoal separates the oxygen, while the lime, combining with the clay, forms a liquid through which the melted iron falls, and is collected at the bottom of the furnace. It is let out and cast in moulds. The cast iron thus obtained, varies considerably according to circumstances. Three varieties have been well distinguished; namely, *white* cast iron, which is very hard and brittle; *grey* or *mottled*, which is softer and less brittle; and *black*, which is the softest and most fusible. Cast iron melts at 130° Wedgewood. Its specific gravity varies from 7.2 to 7.6 It contracts considerably when brought into fusion.

Cast iron is converted into *wrought* or *soft iron*, by keeping it melted for a considerable time in a bed of charcoal and ashes, and the *scoriæ* or *black oxide* of iron, and then forging it repeatedly till it becomes compact and malleable. In this state, it is the substance described in the beginning of this Section under the name of *iron*. It is considered when pure as a simple body; but it is difficult to procure it quite pure. It is almost always contaminated with some foreign body, either some of the other metals, or oxygen, carbon, or phosphorus.

When soft iron is kept red hot for some time in a bed of charcoal, it is converted into *steel*. Steel is so hard, as to be unmalleable while cold. It is brittle, resists the file, cuts glass, strikes fire with flint, and retains the magnetic virtue when impregnated with it. It is more sonorous; and its specific gravity is greater than that of soft iron. It varies from 7.78 to 7.84.

These different states of iron have been long known, and many attempts were made to ascertain the cause of the differences among them. At last it was recognised by Bergman and the French chemists. Soft iron is the simple metal. *Steel* is iron combined with a portion of carbon, and has been for that reason called *subcarburet of iron*. The carbon, from Vauquelin's analysis, amounts to $\frac{1}{140}$th part of the whole. *Cast iron* is iron combined with a still greater proportion of carbon. It usually contains likewise a little oxygen.

4. Iron does not combine with azote.

5. Iron unites with most of the metals. Gold combines readily with iron, and forms a ductile alloy of a pale yellow or white colour, according to the proportions. Platinum is found usually alloyed with iron, but it is difficult to combine the two metals artificially, on account of the high temperature necessary to fuse them. Silver and iron combine, and form a very hard alloy of a white colour. Mercury does not readily unite to iron, but an amalgam may be formed artificially. Iron may be united to copper by fusion, but not without considerable difficulty. The alloy is grey, imperfectly ductile, and very infusible. It is probable that the variety of iron called *hotshort*, because it is brittle when red hot, owes that property to the presence of a little copper with which it is alloyed.

SECT. XI. *Of Nickel.*

Nickel was first recognised as a peculiar metal, in consequence of the experiments of Cronstedt in 1751. It is obtained from an ore which occurs in different German mines, and called *kupfer nickel*, or false copper, because it resembles copper, though no copper can be extracted from it. It has been examined by many eminent chemists, especially by Richter, to whom we are indebted for the most exact account of its properties.

1. Nickel has a white colour like silver; it is softer than iron; its specific gravity, when hammered, is 8.820. It is malleable both cold and hot, and may be easily hammered out into thin plates. It is powerfully attracted by the magnet, and may be converted into a magnet precisely like bars of steel. It requires for fusion a temperature at least equal to 160° of Wedgewood. It is not altered by air nor water.

2. When moderately heated, it tarnishes; and, if in powder, may be even converted into an oxide; but a strong heat reduces it again to the metallic state. We are at present acquainted with two oxides of nickel, the *grey* and the *black*.

The protoxide may be obtained by dissolving nickel in nitric acid, precipitating the oxide by carbonate of potash, washing it, and exposing it to a slight red heat. It is of an ash grey colour, and is composed of 78 nickel, and 22 oxygen. It is tasteless, soluble in muriatic acid, and the solution is grass green. It dissolves likewise in ammonia.

The peroxide may be formed by mixing the protoxide with water, and passing a current of chlorine gas through the liquid. A portion of the oxide dissolves, and a portion acquires a black colour. When this black oxide is dissolved in acids, an effervescence takes place, owing to the escape of a portion of its oxygen.

3. Nickel has not been combined with hydrogen. It is always united with carbon, and it unites readily with phosphorus and sulphur. Cronstedt formed sulphuret of nickel by fusion. The phosphuret may be obtained by dropping bits of phosphorus on red hot nickel.

4. Nickel does not unite with the simple incombustibles.

5. The alloys which it forms are but imperfectly known. They are mostly brittle and hard, and have been applied to no useful purpose.

SECT. XII. *Of Tin.*

Tin was known to the ancients, and was imported from Britain at a very early period by the Phœnicians.

1. Tin has a fine white colour, with a shade of blue It has a slightly disagreeable taste, and emits a peculiar smell when rubbed. It is scarcely so hard as silver. Its specific gravity, when hammered, is 7.299. It is very malleable, and may be hammered out into very thin plates; but its ductility and tenacity are much inferior. A tin wire, 0.078 inch in diameter, is capable of supporting only 34.7 pounds without breaking. When tin is bent it produces a remarkable crackling noise. It melts at 442°; and, when slowly cooled, crystallizes in rhomboidal prisms.

2. Tin soon tarnishes when exposed to the air; but

the tarnished coat is always extremely thin. It is not altered though kept under water; but, at a red heat, it decomposes water, combines with its oxygen, and disengages the hydrogen. When kept melted, it is soon covered with a greyish matter, which becomes speedily yellow. But it is very difficult to oxidize tin completely by heat and air. Tin is capable of forming two different oxides.

The *protoxide*, or grey oxide, may be formed by dissolving tin in muriatic acid by means of heat, and adding potash in excess to the solution. A white powder falls, which is gradually converted into a grey matter, having a good deal of the metallic lustre. This is the grey oxide. It is tasteless; readily soluble in acids; and greedily absorbs more oxygen. It is composed of 55 tin, and 7.5 oxygen.

The *peroxide* may be obtained by heating tin in concentrated nitric acid. A violent effervescence ensues, and the tin is converted into a white powder, which is the peroxide. It dissolves readily in potash and in muriatic acid. It is composed of 55 parts tin and 15.2 oxygen.

Chlorine readily combines with tin, and forms a curious liquid, known by the name of *fuming liquor of Libavius*.

3. Tin has not been combined with hydrogen or carbon, but it unites to phosphorus and sulphur.

Phosphuret of tin may be formed by throwing bits of phosphorus on melted tin. It has the colour of silver; is soft; may be cut with a knife; and extends under the hammer, but separates into laminæ. It is composed of 85 tin and 15 phosphorus.

Sulphuret of tin may be formed by fusing the two ingredients together in a crucible. It is brittle, heavier than tin, and not so fusible. It is of a bluish colour, laminated texture, and capable of crystallizing. It contains 15 parts of sulphur and 55 of tin.

When equal weights of peroxide of tin and sulphur are gradually heated in a retort, some sulphur and sulphurous acid are disengaged, and there is formed a substance called *Mosaic gold*, or *aurum musivum*. It consists of gold-coloured flakes, light, and adhering readily to the skin. Proust has endeavoured to shew, that this substance is a compound of sulphur and protoxide of tin; but his proofs are insufficient. Neither nitric nor muriatic acid acts upon it, but it dissolves in hot nitro-muriatic acid, and is gradually changed into *sulphate of tin*. It dissolves in liquid potash when assisted by heat, and deflagrates when heated with twice its weight of nitre. It consists of tin combined with twice as much sulphur as exists in sulphuret of tin.

4. Tin does not unite with the simple incombustibles, but it combines with the metals, and forms alloys, some of which are of considerable importance.

With gold it unites easily by fusion, and was thought formerly to render the metal very brittle; but the experiments of Alchorne, Hatchett, and Bingley, have shewn that this opinion is, to a considerable degree, erroneous. Tin readily melts with platinum, and forms a brittle alloy, unless the proportion of platinum does not exceed one-ninth of the alloy. The alloy of tin and silver is very brittle and hard. Mercury dissolves tin with facility, and forms an amalgam capable of crystallizing. It is used for silvering the backs of looking-glasses.

Tin unites readily with copper, and forms an alloy known by the names of *gun-metal*, *bell-metal*, *bronze*, and *mirrors of telescopes*, according to the proportion of the ingredients. Tin diminishes the ductility of copper, and increases its hardness, tenacity, fusibility, and sonorousness. The specific gravity is greater than the mean, and is a maximum when the alloy is composed of 100 copper and 16 tin.

Bronze and gun-metal are composed of 100 parts of copper and from 8 to 12 of tin. Brass guns are made of it. The ancients used it for making cutting instruments. The χαλκὸς of the Greeks, and the *æs* of the Romans, was nothing else.

Bell-metal is usually composed of 3 parts of copper and 1 of tin. It is greyish white, very hard, sonorous, and elastic. The mirrors for telescopes consist of about 2 parts copper and 1 tin. This alloy is very hard, the colour of steel, and admits of a fine polish.

When copper is used for culinary vessels, it is covered with a thin coating of tin, and is then known by the name of *tinned copper*. The coating of tin is extremely thin, but it completely prevents the copper from injuring the articles dressed in such vessels.

Tin does not unite readily with iron; but the two metals may be combined by fusing them together in a well closed crucible. The formation of *tin-plate* shows the affinity between the two metals. This very useful compound is made by dipping clean plates of iron into melted tin.

SECT. XIII. *Of Lead.*

Lead was very well known to the ancients, but they do not always seem to distinguish it accurately from tin; though the properties of the two metals be exceedingly different.

1. Lead has a bluish white colour, and, when newly melted, is very bright; but it soon tarnishes when exposed to the air. It is tasteless; but, when rubbed, emits a peculiar smell. It stains the fingers or paper dark blue. When taken internally, it is poisonous. It is very soft. Its specific gravity is 11.407. It is not increased by hammering. It is very malleable; but its ductility and tenacity are not great. A lead wire, 0.078 inch in diameter, is capable of supporting only 27.7 lbs. without breaking. It melts at 612°. When slowly cooled, it crystallizes in 4 sided pyramids.

2. Lead soon tarnishes in the open air, but the oxidizement never proceeds far. Water does not act upon it, though it greatly facilitates the action of the external air. Lead is believed at present to be capable of forming 3 different oxides.

The *yellow oxide* is the most important, as it constitutes the basis of almost all the known salts of lead. It may be obtained by dissolving lead in nitric acid, precipitating by carbonate of potash, and heating the white powder, which falls almost to redness. It is yellow, tasteless, insoluble in water, but soluble in potash and in acids. It readily melts, and forms a brittle semitransparent hard glass. It is composed of 100 lead and 7.7 oxygen. It may be formed by exposing lead for a sufficient time to the action of heat and air, and is then known by the name of *massicot*.

If yellow oxide be dissolved in nitric acid, and the solution boiled over a quantity of lead filings in a phial, the liquid assumes a yellow colour, and yields yellow, brilliant crystals, in scales. These crystals, according to Proust, consist of nitric acid united to an oxide of lead, containing less oxygen than yellow oxide. But his experiments have not been verified by subsequent inquirers.

If massicot, ground to a fine powder, be exposed in a furnace to the flame of burning coals, playing upon its surface for about 48 hours, it is converted into a beautiful red powder, called *minium*, or *red lead*. This is the *deutoxide* or *red oxide* of lead. It is of an orange red colour, of the specific gravity of 8.940; insoluble in water, but soluble in potash. When heated to redness, it gives out oxygen gas, and is partly reduced, and partly melted, to a dark brown glass. It does not combine with acids. When acids dissolve it, they first reduce it to the state of yellow oxide. It is composed of 90 lead, and 10 oxygen.

If weak nitric acid be poured upon red lead, a portion is dissolved, but a portion remains in the state of a dark *brown powder*. This brown powder is the peroxide of lead. It is tasteless, light, and is not acted on by sulphuric or nitric acid. To muriatic acid it gives out oxygen, and converts it into oxymuriatic acid. It is composed of 86.5 lead, and 13.5 oxygen.

When lead is first extracted from its ore, it almost always contains a portion of silver, which is always extracted, when its quantity is sufficient to repay the expence. The process is known by the name of *refining* the lead. The lead is placed in a large flat dish, called a *test*, composed of burnt bones and fern ashes, and exposed to the flame of a furnace. The lead gradually assumes a kind of vitriform state, and is either blown off or sinks into the test, while the silver remains unaltered. The lead by this process is converted into *litharge*. It consists of fine scales, partly red and partly yellow. It is yellow oxide, combined with a small portion of carbonic acid.

3. Lead has not been combined with hydrogen or carbon, but it unites to phosphorus and sulphur.

Phosphuret of lead may be formed by dropping phosphorus into melted lead. It has a silver white colour, with a shade of blue, and soon tarnishes.

Sulphuret of lead may be formed by mixing the two ingredients, and melting them in a crucible. It occurs abundantly native, and is known by the name of *galena*. It is brittle, brilliant, of the colour of lead, less fusible, and usually crystallizes in cubes. Its specific gravity is about 7. It is composed of 86.5 lead, and 13.5 sulphur.

There is another sulphuret of lead, which has been occasionally found native also. The colour is lighter, and it burns with a blue flame when placed upon burning coals. It contains at least 25 per cent. of sulphur.

4. Lead does not combine with the simple incombustibles. It forms alloys with the other metals, but few of them are of much importance.

It renders gold as brittle as glass, when the proportion of it does not exceed $\frac{1}{1920}$th of the gold. It likewise renders platinum brittle. The alloy of silver and lead is very brittle; its specific gravity is greater than the mean. Mercury readily dissolves lead, and forms an amalgam capable of crystallizing. Copper dissolves in lead at a strong red heat. The alloy is grey and brittle, and, when heated gradually, the lead melts and runs off, leaving the copper nearly pure. Iron unites with lead with difficulty, and the alloy is easily decomposed. Lead and tin may be combined in any proportion. The alloy is harder, and possesses more tenacity than tin.

Sect. XIV. *Of Zinc.*

The ancients do not appear to have been acquainted with this metal. It has been long known in China, and is mentioned by European writers in the 13th century. The method of extracting it from its ores was unknown in Europe till near the middle of the 18th century.

1. Zinc has a brilliant white colour, with a shade of blue, and is composed of thin plates cohering together. It has a sensible taste, and acquires, when rubbed, a slight smell. It is rather harder than silver. When hammered, its specific gravity is 7.1908. In its usual state it can scarcely be said to be malleable; but when heated a little above 212°, it becomes very malleable, and may be rolled out into thin plates, or drawn into wire. A zinc wire 0.078th inch in diameter is capable of supporting 109.8 lbs. When heated to about 680°, it melts, and, if cooled slowly, crystallizes in quadrangular prisms.

2. When exposed to the air, its surface is soon tarnished, but it hardly undergoes any other change. It is said to decompose water slowly, and to separate the hydrogen. At a red heat, the decomposition goes on rapidly. When zinc is heated to redness, it takes fire, and burns with great brilliancy, being converted into a white oxide, which flies off in fine flakes like cotton. It was called *pompholyx*, *nihil album*, *lana philosophica*, *flowers of zinc*.

Only one oxide of zinc is known. It is the *peroxide*, or the white oxide obtained by the combustion of the metal. It is composed of 80.39 parts zinc and 19.61 oxygen. It may be obtained likewise by dissolving zinc in sulphuric acid, and precipitating by means of potash. It is very white, light, and has some resemblance to chalk. It is tasteless and insoluble in water, and is not altered by exposure to the air.

3. Most of the simple combustibles combine with zinc. Hydrogen gas, procured by the action of diluted sulphuric acid on zinc, holds a little of the metal in solution, which it gradually deposites.

Carbon was considered as an occasional constituent of zinc, and supposed to occasion the appearance of the black powder which separates when zinc is dissolved in sulphuric acid. But on examining this powder, it was found a mixture of copper and lead.

Phosphuret of zinc may be formed by dropping bits of phosphorus upon melted zinc. It has a considerable resemblance to lead. It is somewhat malleable. Phosphorus combines likewise with the oxide of zinc.

Sulphuret of zinc exists native in considerable quantity, and is known by the name of *blende*. It may be formed by fusing a mixture of sulphur and oxide of zinc.

4. Zinc does not unite with the simple incombustibles, but it combines with the metals, and forms alloys, some of which are of great importance.

It renders gold brittle, even when added in a very minute proportion. It melts readily with platinum, and renders it brittle. Silver readily combines with it, and forms a brittle alloy. Mercury easily amalgamates in any proportion, when poured upon hot zinc. The amalgam is used to increase the energy of electric machines.

Zinc combines with copper, and forms one of the most useful of all the alloys, namely, *brass*. It is prepared by mixing oxide of zinc, charcoal powder, and granular copper, and heating them sufficiently in a crucible. Brass is yellow. The proportion of zinc which it contains varies somewhat. In some British manufactures it amounts to one-third, while in Germany and Sweden it is said not to exceed one-fourth or one-fifth. Brass is much more fusible than copper. It is malleable while cold, but becomes brittle when heated. It is ductile, may be drawn into fine wire, and is much tougher than copper. When zinc in the metallic state is melted with copper, the alloy is known by the name of *pinchbeck*, *prince's metal*, *Prince Rupert's metal*. The colour of pinchbeck approaches more nearly to that of gold, but it is more brittle than brass.

Zinc cannot easily be alloyed with iron. The alloy is hard and white, and somewhat ductile. Tin and zinc easily unite. The alloy is hard and ductile. Lead and zinc may be united by fusion.

SECT. XV. *Of Bismuth.*

This metal was unknown to the ancients. It was well known in Germany at the beginning of the 16th century. But chemists were long in reckoning it a peculiar metal.

1. Bismuth is of a reddish white colour, and almost destitute of taste and smell. It is composed of broad brilliant plates adhering to one another. It is harder than silver. Its specific gravity is 9.822. When hammered cautiously, its density is increased, but it breaks when struck smartly. It cannot be drawn out into wire. A rod of one-tenth inch diameter is capable of supporting about 29 lbs. It melts at 476°, and may be distilled over in close vessels. When cooled slowly, it crystallizes in parallelopipeds.

2. It tarnishes in the air, but is not altered when kept under water. When kept melted in an open vessel, it is gradually converted into a yellow powder. In a strong red heat it takes fire, and burns with a faint blue flame, and emits a yellow smoke. This, when collected, is a *yellow oxide.* It is composed of about 89.3 bismuth, and 10.7 oxygen. This is the only oxide of bismuth at present known. It is tasteless and insoluble in water. When heated it melts into a brown glass.

3. Bismuth has not been combined with hydrogen or carbon. It does not seem capable of combining in any notable proportion with phosphorus. But it unites very readily with sulphur by fusion. The sulphuret is bluish grey, very brittle and fusible, and crystallizes in four-sided needles. It is composed of about 85 bismuth and 15 sulphur.

4. Bismuth does not unite with the simple incombustibles, but it combines with the metals, and forms alloys not hitherto applied to any useful purpose. It renders gold, platinum, and silver, brittle. It amalgamates readily with mercury. When the mercury exceeds, the amalgam is fluid, and has the property of dissolving lead, and rendering it also fluid. Bismuth renders copper and iron brittle. It facilitates the fusion of tin and lead: a mixture of eight parts bismuth, five lead, and three tin, is called fusible metal, because it melts at 212°. Bismuth does not combine with zinc.

SECT. XVI. *Of Antimony.*

The ancients were acquainted with some of the ores of antimony, but it does not appear that they knew the metal itself. Who first extracted it from its ores is unknown. But the process is first described by Basil Valentine.

1. Antimony is of a greyish-white colour, and has considerable brilliancy. Its texture is laminated, and exhibits plates crossing each other in every direction. It is as hard as silver. Its specific gravity is 6.712. It is very brittle, and may be easily reduced to powder in a mortar. It melts at 810°, or when just red hot; and, when cooled slowly, forms oblong crystals perpendicular to the internal surface of the vessel in which it cools.

2. When exposed to the air it loses its lustre, but undergoes no other change. Neither is it altered by cold water, but at a red heat it decomposes water, and combines with its oxygen, while hydrogen gas is emitted. When heated in an open vessel, it gradually combines with oxygen, and evaporates in a white smoke, which, when collected, was formerly called *argentine flowers of antimony*. When suddenly heated, antimony burns, and is converted into the same white oxide. Two oxides of antimony are known.

The protoxide may be obtained thus. Dissolve antimony in muriatic acid, dilute the solution with water; a white powder falls, wash it and boil it in a solution of *carbonate of potash*. Then wash and dry it. The protoxide thus obtained is a dirty white powder. At a moderate red heat, it melts, and becomes opake, and crystallizes in needles on cooling. It is composed of 81.5 antimony, 18.5 oxygen.

The peroxide may be obtained by keeping the antimony in a red heat; for the argentine flowers are peroxide of antimony. It may be obtained also by dissolving antimony in nitric acid, or by throwing it into red hot nitre. It is white, insoluble in water, and less soluble in acids than protoxide. It is easily volatilized by heat, but requires a pretty high temperature for fusion. It is composed of 77 antimony, and 23 oxygen.

3. Antimony has never been combined with hydrogen or carbon; but it unites readily to phosphorus and sulphur.

Phosphuret of antimony may be formed by dropping bits of phosphorus into melted antimony. It is white, brittle, and appears of a laminated structure.

Sulphuret of antimony exists native, and was formerly distinguished by the name of *antimony*, the pure metal being called *regulus of antimony*. It has a dark-bluish grey colour, and the metallic lustre. It is brittle, and often crystallized. It is composed of 75 antimony and 25 sulphur.

The protoxide of antimony has the property of dissolving different portions of the sulphuret by means of heat, and forming with it a vitreous substance of a reddish brown colour, and differing in transparency according to the proportion of sulphuret. It is called *glass of antimony*, *crocus metallorum*, *liver of antimony*, according to its appearance.

4. Antimony does not combine with the simple incombustibles. But it forms alloys with almost all the metals. It renders other metals brittle, and none of its alloys is of much consequence, except the alloy of tin and antimony, which constitutes *pewter;* and of lead and antimony, which constitutes the metal of printers types.

SECT. XVII. *Of Tellurium.*

This metal has been hitherto found only in the mine of Mariahilf in Transylvania. Its peculiar nature was first suspected by Muller of Reichenstein in 1782, and fully proved by the experiments of Klaproth in 1798.

1. Its colour is bluish white, its texture laminated, and its brilliancy considerable. It is very brittle. Its specific gravity is 6.115. It melts a little above the melting point of lead, and may be easily distilled over in close vessels. When cooled slowly it crystallizes.

2. When exposed to the blowpipe on charcoal, it burns with a blue flame, and is converted into a white oxide, which disperses in smoke. The same oxide may be obtained by dissolving the tellurium in muriatic acid, and diluting with water. When heated, it melts into a straw-coloured mass.

3. Tellurium may be combined with sulphur by fusion. The sulphuret has a leaden grey colour and radiated texture. Mr Davy has lately discovered that tellurium combines readily with hydrogen,[*] and forms a gas soluble in water, and possessing, like sulphureted hydrogen, the characters of a weak acid. The action of the other simple combustibles has not been tried.

4. It may be amalgamated with mercury; but we are ignorant of the metallic alloys which it is capable of forming.

Sect. XVIII. *Of Arsenic.*

The ancients gave the name of *arsenic* to a compound of arsenic and sulphur. The *white oxide of arsenic*, known in commerce by the name of arsenic, must also have been known to them. But they do not seem to have been acquainted with the substance which we call arsenic in its metallic state. The discoverer of this substance is unknown. But Brandt first ascertained its properties in 1733.

1. Arsenic has a bluish white colour, and a good deal of brilliancy. When heated in the open air, it blackens, smokes, and emits the odour of garlic. It is the softest metal known. Its specific gravity is 8.31. It is remarkably brittle. It is very volatile, subliming without melting when heated to 356°. When slowly sublimed, it crystallizes in tetrahedrons.

2. It may be kept under water without alteration, but in the open air it soon falls into a black powder. We know two oxides which it is capable of forming.

The *white oxide* is obtained by exposing arsenic to a moderate heat. The metal takes fire, emits the smell of garlic, and is volatilized in a white smoke, which is the oxide in question. It is obtained in the large way during the smelting of various ores which contain arsenic. It is white, compact, and like glass. Its taste is acrid and sweet, and it is one of the most virulent poisons known. It dissolves in water, and exhibits different properties of an acid. It dissolves also in alcohol, and in oils. It crystallizes in tetrahedrons. It sublimes at the heat of 383°. Its specific gravity varies from 3.7 to 5.000 according to its state. It is composed of 75.2 arsenic, and 24.8 oxygen.

The peroxide of arsenic was discovered by Scheele. It is usually called *arsenic acid*. It may be obtained by dissolving white oxide of arsenic in nitro-muriatic acid, evaporating to dryness, and applying sufficient heat to drive off these acids. In this state it is a white mass, which readily dissolves in water. Its taste is excessively sour, and it possesses all the other properties of an acid. It is composed of 65.4 parts of arsenic and 34.6 of oxygen.[†]

3. Arsenic combines readily with the simple combustibles, carbon excepted, with which it has not hitherto been united.

When a mixture of tin and arsenic, or of zinc and arsenic, is dissolved in muriatic acid, the hydrogen which exhales holds a considerable portion of arsenic in solution, and is known by the name of *arsenical hydrogen*. This gas possesses some curious properties, which have been investigated by Trommsdorff and Stromeyer.

Phosphuret of arsenic may be formed by mixing the two constituents, and distilling them together over a moderate fire. It is black and brilliant, and ought to be kept under water.

Sulphur combines readily with arsenic by heat. Two distinct compounds of these two bodies are found native. The first, called *realgar*, is of a scarlet colour, and often crystallizes in transparent prisms. It is tasteless, and not nearly so poisonous as arsenic. It is composed of 60 arsenic and 30 sulphur. The second compound is called *orpiment*. It is of a fine yellow colour, and may be formed by pouring a solution of sulphureted hydrogen into arsenic dissolved in water. It is foliated, and much heavier than realgar. According to Thenard, it is composed of three sulphur and four arsenic.

4. Arsenic does not combine with the simple incombustibles, but it unites with the metals, and renders them brittle. None of its alloys have been applied to any useful purpose.

Sect. XIX. *Of Cobalt.*

Cobalt occurs in different mines in Germany and England, and has been long employed to give a blue colour to glass. Its peculiar properties were first ascertained by Brandt, in 1733.

1. Cobalt has a grey colour, with a shade of red, and is not very brilliant. It is of the hardness of silver, or a little harder. Its specific gravity is 7.7. It is brittle, and easily reduced to powder. It melts at 130° Wedgewood, and crystallizes as it congeals. It is attracted by the magnet, and may itself be converted into a magnet

2. It is not altered by air nor water at the ordinary temperature of the atmosphere, but in a red heat it is gradually converted into an oxide. We are acquainted with 3 oxides of cobalt.

The protoxide is blue. It may be obtained by dissolving cobalt in nitric acid, precipitating by potash, washing and drying the powder, and exposing it to a red heat for some time. It dissolves in acids without effervescence. It is composed of 83⅓ cobalt and 16⅔ oxygen.

Moist protoxide, when exposed to the air, gradually absorbs oxygen, and assumes an olive colour. This is the deutoxide of cobalt. When digested in muriatic acid, oxymuriatic acid flies off, and a solution of protoxide is obtained.

By gradual exposure to the air, more oxygen is absorbed, and the oxide becomes black. This is the peroxide. It forms abundance of oxymuriatic acid gas when digested in muriatic acid. It is composed of 80 cobalt and 20 oxygen.

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[*] It appears from Davy's account, to be only held in solution by hydrogen.—*Elem.* p. 233. Coxe.

[†] Here are other evidences of the impropriety of many chemical terms: The same substances are denominated oxyds, and acids. As they unquestionably possess many of the properties of the last mentioned bodies, the name of oxyds should be altogether rejected. Coxe.

3. Cobalt does not combine with carbon or hydrogen. Sulphuret of cobalt may be formed by melting the metal with sulphuret of potash. It is yellowish white, and is composed of 71½ cobalt and 28½ sulphur.

Phosphuret of cobalt may be formed, by throwing bits of phosphorus upon red hot cobalt. It is white and brittle, and soon loses its metallic lustre.

4. Cobalt does not combine with the simple incombustibles. It unites with the different metals, and forms alloys which have been but imperfectly examined.

SECT. XX. *Of Manganese.*

Ores of the metal called manganese are common, in which it occurs always in the state of an oxide. Scheele, Bergman, and Gahn, are the chemists to whom we are indebted for the first investigation of its properties. Of late, a valuable set of experiments on it have been made by Dr John of Berlin.

1. Manganese, when pure, is of a greyish white colour, similar to cast iron. Its texture is granular. It is brittle, and rather softer than cast iron, as it may be filed. Its specific gravity is 8.013.

2. When exposed to the air, it begins immediately to absorb oxygen, and soon falls to powder. We are acquainted with three oxides of this metal, distinguished from each other by their colours, namely, the *green*, the *brown*, and the *black*. The protoxide, or green oxide, is formed when manganese is thrown into water. The water is decomposed, and the metal assumes the form of a green powder. It is composed of

87 metal.
13 oxygen.
——
100

The deutoxide, or brown oxide, is formed by exposing the green oxide to the air. It absorbs an additional dose of oxygen, and assumes a brown colour. This oxide is composed of

80 metal.
20 oxygen.
——
100

The peroxide, or black oxide, occurs native in great abundance. It may be formed artificially, by dissolving manganese in nitric acid, and evaporating to dryness. It is composed of

71.33 metal.
28.67 oxygen.
——
100.00[*]

3. Manganese does not combine with hydrogen or carbon, but it unites with phosphorus and sulphur.

Phosphuret of manganese may be formed by dropping phosphorus on red hot manganese. It is white, brittle, granular, and disposed to crystallize.

Bergman did not succeed in his attempts to combine sulphur with manganese. But he formed a sulphureted oxide, by heating 8 parts of black oxide and 3 parts of sulphur.

4. Manganese does not combine with the simple incombustibles; but it unites with the metals, and forms alloys which have been but imperfectly examined.

SECT. XXI. *Of Chromium.*

This metal was discovered by Vauquelin, who extracted it from the red lead ore of Siberia. Owing to the violent heat necessary to fuse it, its properties are but imperfectly known.

1. Its colour is white, intermediate between that of tin and steel. Its specific gravity is 5.90. It is very brittle, assumes a good polish, and is magnetic, though inferior in this respect to iron, nickel, and cobalt. Acids act upon it with great difficulty. It requires a very high temperature to melt it, so that hitherto it has only been obtained in small grains.

2. Chromium is not altered by exposure, but when heated in the open air, it is gradually oxidized. Three oxides of this metal are known.

The protoxide, or green oxide, may be obtained by exposing chromic acid to heat in close vessels. Oxygen is disengaged, and the green oxide remains behind.

The deutoxide is intermediate between the green oxide and chromic acid. Its colour is brown.

The peroxide, or chromic acid, is found native in *red lead ore.*[†] It is of a red, or orange colour, soluble in water, and composed of one part chromium and two parts oxygen.

The remaining properties of chromium have not been examined.

SECT. XXII. *Of Uranium.*

This metal was discovered by Klaproth, and extracted by him from an ore which occurs in Saxony, and is known by the name of *pechblende*.

1. It requires so violent a heat to melt it, that hitherto the fusion has only been imperfectly accomplished. Its colour is iron grey, it has considerable lustre, and is soft enough to yield to the file. Its specific gravity is 9.000.

2. It forms various oxides, which have been hitherto only examined by Bucholz.

When heated to redness, it undergoes a species of combustion, and is converted into a greyish black powder, which is the protoxide. It is composed of 95 uranium and 5 oxygen.

When uranium is dissolved in nitric acid, and precipitated by potash, it is obtained in the state of a peroxide. It is a yellow, tasteless powder, insoluble in water. It dissolves with effervescence in muriatic acid, oxymuriatic acid gas being exhaled. It is composed of 80 metal and 20 oxygen.

Besides these two oxides, Bucholz is of opinion, that there are several others intermediate between them, distinguishable by their colour. He recognized four, namely, *the violet*, *the greenish brown*, *the greyish green*, *and the orange*.

3. Uranium is capable of uniting with sulphur. No experiments have been made of the action of the other simple combustibles on it. Neither do we know the action of the simple incombustibles, or the alloys which it forms with other metals.

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[*] It is from this oxyd that oxygen is principally obtained, in large amount, by exposure to a high temperature. COXE.

[†] It is also found united to iron, very abundantly, in Pennsylvania and Maryland. See *Baltimore Med. and Philos. Jour.* vol. i. COXE.

SECT. XXIII. *Of Molybdenum.*

This metal is extracted from a scarce mineral called *molybdena*, first examined by Scheele. Molybdenum was first obtained in the metallic state by Hielm.

1. Hitherto it has only been obtained in small grains simply agglutinated. Its colour is silvery white. Its specific gravity is 8.611. It is brittle, not altered though kept under water, but the effect of air is unknown.

2. When heated in the open air, it gradually combines with oxygen, and is volatilized in the form of small white needles. It seems capable of forming four different oxides.

The protoxide is brown. It is obtained by exposing molybdenum in powder to a red heat.

By exposing it to a longer and more violent heat, it becomes *violet brown*. This Bucholz considers as a second oxide.

The *blue* oxide may be obtained by carrying the heat a little farther, or by triturating together one part of molybdenum and two parts of molybdic acid, boiling the mass in water, and evaporating the liquid to dryness. This oxide possesses several properties of an acid. It converts vegetable blues to red, and combines with saline bases, and forms salts. It may be called *molybdous acid*. It is composed of 100 metal and 34 oxygen.

The *white* oxide, or *molybdic acid*, is obtained by roasting molybdena for some time, dissolving the grey powder in ammonia, and pouring nitric acid into the solution. The oxide precipitates in fine white scales, which, when melted and sublimed, become yellow. It converts vegetable blues to red, but does not act so powerfully as the blue oxide. It is composed of two parts metal and one part oxygen.

3. Molybdenum combines with phosphorus and sulphur, but not with carbon and hydrogen.

Sulphuret of molybdenum occurs *native*, and is usually called *molybdena*. It is of a bluish grey colour, has the metallic lustre, and is composed of plates. It consists of 60 parts metal and 40 sulphur.

4. The simple incombustibles do not combine with molybdenum; but it unites with the metals, and forms alloys which hitherto have been examined only by Hielm. None of them are of much importance.

SECT. XXIV. *Of Tungsten.*

Tungsten was discovered by Scheele, and reduced to the metallic state by the D'Elhuyars. It is so difficult of fusion, that hitherto it has been very seldom procured in a tolerably compact state. It is sometimes called *Scheelium*, after the discoverer.

1. It is of a greyish white colour, and has a good deal of brilliancy. It is very hard, and seems to be brittle. Its specific gravity is 17.6. It requires a temperature at least equal to 170° Wedgewood to melt it. It is not magnetic.

2. When heated in an open vessel it is gradually oxidized. We are acquainted with two different oxides of this metal, the *blue* and the *yellow*.

The *protoxide*, or *blue* oxide, may be obtained by heating the yellow oxide for some hours in a covered crucible.

The *peroxide*, or *yellow* oxide, may be obtained by boiling tungsten, or its ore, in muriatic acid, decanting off the acid, and allowing it to settle. A yellow powder gradually precipitates. This yellow powder is to be dissolved in ammonia, the solution evaporated to dryness, and the residue kept for some time in a red heat. This yellow oxide is composed of 80 parts metal and 20 oxygen. It combines with bases, forms salts, and therefore has been considered as an acid. Its specific gravity is 6.12.

3. Tungsten combines with sulphur and phosphorus, but not with hydrogen or carbon.

4. The simple incombustibles do not unite with it, but it combines with the metals and forms alloys, hitherto examined only by the Elhuyarts.

SECT. XXV. *Of Titanium.*

This metal was discovered by Mr Gregor; but it received its name from Klaproth, who discovered it without any knowledge of the labours of Gregor.*

1. It is so refractory that most persons have failed in their attempts to reduce it. Lampadius is said to have succeeded. Its colour is that of copper, and it has considerable lustre. It is brittle, but elastic.

2. It is easily oxidized by exposure to heat and air. We know three oxides of titanium, the *blue*, the *red*, and the *white*.

The protoxide, which is *blue*, or *purple*, is formed by exposing titanium hot to the open air.

The red oxide is found native. It is often crystallized in four-sided prisms. Its specific gravity is 4.2, and it is hard enough to scratch glass. By a very violent heat it seems to be partially oxidized. It appears to be composed of 100 metal and 33 oxygen.

The *peroxide*, or white oxide, may be obtained by fusing the red oxide in a crucible with four times its weight of potash, and dissolving the whole in water. A white powder gradually precipitates, which is the oxide in question. It is composed of about two parts metal and one oxygen.

3. Titanium has been combined with none of the simple combustibles except phosphorus. The phosphuret is of a white colour, brittle, and granular, and does not melt before the blowpipe.

4. Hitherto titanium has been alloyed with none of the metals, except iron.

SECT. XXVI. *Of Columbium.*

This metal was discovered by Mr Hatchett during the analysis of an ore from America, deposited in the British museum. He obtained from the mineral a white powder, which possessed acid properties peculiar to itself. He shewed that this powder was a metallic oxide; but all attempts to reduce it to the metallic state were unsuccessful. We are at present ignorant of the properties of this metal.

Ekeberg, a Swedish chemist, announced, some years ago, that he had discovered a peculiar metal, to which he gave the name of tantalum. Dr Wollaston has lately proved, that this new metal is the same with Mr Hatchett's columbium.

SECT. XXVII. *Of Cerium.*

This metal was discovered by Hisinger and Berzelius in a mineral found in a Swedish copper mine, and at first confounded with tungsten. To procure the oxide of cerium is easy, but all attempts to reduce that oxide to the metallic state have failed. The metal appears to be volatile, and is dissipated by a violent heat, while a moderate heat is not sufficient to reduce it.

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* The ores of this metal appear to be very numerous in the United States. See an interesting paper on this subject, in the American Mineralogical Journal, vol. i. No. 4—by the learned Editor of that useful work. CONF.

1. Cerium appears to be white and brittle; but its other properties are unknown.

2. It forms, at least, two oxides, the *white* and the *red*; and, according to the Swedish chemists, there are two oxides intermediate between these, the *yellow* and the *brown*.

3. We are unacquainted with the effect of the simple combustibles and incombustibles on cerium. It has been alloyed with iron, but with no other metal.

Sect. XXVIII. *General Remarks.*

The following Table exhibits a synoptical view of some of the principal properties of the metals.

Metals.	Colour.	Hardness	Specific Gravity.	Melting Point.		Tenacity
				Fahrenheit	Wedgewood	
Gold	Yellow	6.5	19.361		32	150 07
Platinum	White	8	23 000		1 0	274.31
Silver	White	7	10.510		22	187.13
Mercury	White	0	13 568	—39		
Palladium	White	9	11.8[illegible]		160+	
Rhodium	White		11. +		160+	
Iridium	White				160+	
Osmium	Blue				160+	
Copper	Red	7.5	8.805		27	302.26
Iron	Grey	9	7.8		158	549.25
Nickel	White	8.5	8.820		160+	
Tin	White	6	7.299	442		34.70
Lead	Blue	5.5	11 352	612		27.70
Zinc	White	6.5	6.861	680		109 80
Bismuth	Reddish-white	7.	9 822	476		20.10
Antimony	White	6.5	6.712	810		7.
Tellurium	White		6.115	612+		
Arsenic	White	5	8.310	400+		
Cobalt	Grey	6	7 7		130	
Manganese	Grey	9	8.01[illegible]		160	
Chromium	White		5 90		170+	
Uranium	Iron-grey		9 000		170 +	
Molybdenum	White		8.611		170+	
Tungsten	White	9+	17.600		170+	
Titanium	Red				170+	
Columbium					170+	
Cerium	White				170+	

2. All the metals are capable of combining with oxygen. The knowledge of the number of oxides, and of the proportion of oxygen which they contain, is of great importance. The following Table exhibits a list of these oxides, as far as known, of their colours, and of the quantity of oxygen in each, combined with 100 parts of metal.

Metals.	*Oxides.*	*Colours.*	*Oxygen.*
Gold	1 2	Purple Yellow	 32
Platinum	1 2	Green Brown	7.5 15
Silver	1 2	—— Olive	 7.925
Mercury	1 2	Black Red	5 10
Palladium	1 2	Blue Yellow	
Rhodium	P*	Yellow	
Iridium	1 2	Blue? Red?	
Osmium	P	Transpar.	
Copper	1 2	Red Black	12.5 25
Iron	1 2 3	—— Black Red	 29.5 44.25
Nickel	1 2	Grey Black	28
Tin	1 2 3	—— Grey White	— 25 38.8
Lead	1 2 3	Yellow Red Brown	7.7 11 1 15.4
Zinc	1	White	24.4
Bismuth	P	Yellow	12
Antimony	1 2	White White	22.7 30
Tellurium	P	White	
Arsenic	1 2	White Acid	33 53
Cobalt	1 2 3	Blue Green Black	19 7 25
Manganese	1 2 3	Green Brown Black	15 25 40
Chromium	1 2 3	Green Brown Red	 200
Uranium	1 2	Black Yellow	5 17 28
Molybdenum	1 2 3 4	Brown Violet Blue White	 34 50
Tungsten	1 2	Black Yellow	15 25
Titanium	1 2 3	Blue Red White	16 33 49
Columbium	P	White	
Cerium	1 2	White Red	

3. Of the simple combustibles, *carbon* has been only united hitherto to two metals, namely, *iron* and *nickel*: hydrogen gas dissolves arsenic, zinc, and iron, seemingly in the metallic state: phosphorus combines with most of the metals hitherto tried; but these compounds have been applied to no useful purpose: sulphur likewise combines with most metals; the sulphurets are often found native; some of them are prepared artificially, as paints: we do not know the action of boracium on the metals.

4. The action of the simple incombustibles on metals is not striking.

5. The combinations of the metals with each other, called *alloys*, are some of them, as those of zinc and tin, of great importance. The greater number of them have only been very superficially examined.

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* The letter P in the second column signifies *Peroxide*.

DIVISION II.

Of Unconfinable Bodies.

The unconfinable bodies cannot be examined directly, because we have no method of retaining them till we ascertain their properties. We can only draw inferences respecting them, by seeing the changes produced upon those bodies into which they enter, or from which they separate. They are four in number, namely, *light*, *heat*, *electricity*, and *magnetism*. But the examination of the two last is not considered as the province of chemistry. The two first will occupy our attention in the following chapters.[*]

Chap. I.

Of Light.

Every person is acquainted with the light of the sun, and of burning bodies, and that it is by means of light that bodies are rendered visible.

Huygens considered light as a subtile fluid filling space, and rendering bodies visible by the undulations into which it is thrown. While Newton, and almost all other philosophers, consider it as a subtile substance, constantly separating from luminous bodies, moving in straight lines, and rendering bodies visible by entering the eye.

Light takes about 8 minutes in moving across half the earth's orbit, which is a space exceeding 94 millions of miles; of course its velocity is not much less than 200,000 miles in a second. From this velocity, joined to the imperceptible effect produced by the impulse of the particles of light on other bodies, it is obvious that its particles are inconceivably minute. Hence the reason that they produce no perceptible effect upon the most delicate balance.[†]

While a ray of light moves in the same medium, or when it passes perpendicularly from one medium to another, it does not change its direction. But when it passes obliquely from one medium to another, it changes its direction, and is then said to be *refracted*. When it passes from a rarer to a denser medium, it is refracted *towards* the perpendicular; when from a denser to a rarer, it is refracted *from* the perpendicular. In the same medium, the sines of the angles of incidence and refraction have a constant ratio.

When a ray of light strikes obliquely against a plane surface, even though transparent, instead of passing through, it is bent back in a contrary direction. Just as would happen if an elastic ball were made to strike obliquely against the ground. The ray is then said to be *reflected*. The angle of reflection is always equal to the angle of incidence.

When a ray of light passes within a certain distance of another body, it is bent *towards* it; at a different distance it is bent *from* it. In the first case, the ray is said to be *inflected*, in the second to be *deflected*.

When a ray of light is made to pass through a triangular glass prism, and received upon a sheet of paper, the image or *spectrum*, as it is called, instead of being round, is oblong. This spectrum exhibits seven different colours, in the following order, beginning with the lowest; *red*, *orange*, *yellow*, *green*, *blue*, *indigo*, *violet*. In this case the refraction of the ray is increased by the figure of the prism; and if it be heterogeneous, and consist of rays differing in refrangibility, they will separate from each other, the most refrangible going to the top of the spectrum, the least refrangible to the bottom, and the others in their order. This is the case. Light consists of seven different rays, distinguished by seven different colours. The *red* is the *least* refrangible, and the *violet* the *most*. The refrangibility of the rest is in the order of their names.

The rays of light differ in their power of illuminating objects. The lightest green or deepest yellow gives the most light, and the light diminishes as we approach either extremity of the spectrum. The violet has the least illuminating power.

Light is capable of entering into bodies and remaining in them, and of afterwards being extricated by various means. Such bodies are said to *phosphoresce*. Almost all bodies possess this property to a certain extent. If they be exposed to the sun, and suddenly carried to the dark, they are luminous for some time, but in general for a very short period. Some bodies seem to contain light as a constituent, from which it may be extricated by various means. Thus fluor spar, and various other minerals, become luminous when heated. Herring, other fish, meat, and wood, often become luminous just before they begin to putrefy, and often continue luminous for a considerable time.[*]

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[*] If oxygen and the other gases owe their aëriform state to caloric, this division, by which oxygen, &c. is placed amongst the confinable bodies, is evidently improper; since, although we can confine those gases in appropriate vessels, yet, as we are unacquainted with the bases of several of them, it is impossible to say whether they are, or are not, to be arranged according to this division. Coxe.

[†] If, however, light be material, it must be possessed of gravity, however unappreciable by any means in our power; and if so, if heat and light escape in combustion from oxygen gas, or from the combustible, those bodies *must be* proportionally diminished in weight; although we are told that the substance or product of combustion is *accurately* the same in weight with the bodies employed. A position, apparently, to the full as absurd as the doctrine that maintained phlogiston to be a principle of levity. *Ibid.*

[*] It may be a question if this point is absolutely proved. That bodies, by exposure to light, may for a time become possessed of a power of refracting the circumambient matter of light, so as to render certain primitive rays evident, I do not doubt; but if they retain or incorporate the light to which they are exposed, then the light they are supposed to emit ought, at least, to be that to which only they are exposed. But this, I apprehend, is disproved by an observation of Mr Davy, in his Elements of Chemistry, vol. i. p. 123. He there tells us, that "when a mixture of calcined oyster-shells and sulphur, that have been heated together, is exposed to the solar rays, it forms a good solar phosphorus, it becomes luminous, and continues so for some minutes in the dark; and *to which ever* of the prismatic rays it be exposed, its light *is always the same*, pale yellow."—Now, how can we explain, by the common received opinion, that this phosphorescent body, exposed to the red, orange, violet, or indigo rays, should only give off "pale yellow" light? Coxe.

Light produces considerable changes upon certain bodies. The *green colour* of plants is owing to it; for when they vegetate in the dark, they are white.* Nitric acid is decomposed by exposure to the light, and oxygen gas emitted. The oxide of silver, and perhaps also of gold, is reduced by exposure to light. Till lately, it was supposed that these changes were produced by the colorific rays of light. But it has been recently ascertained, that muriate of silver is blackened most rapidly when placed beyond the violet ray, and entirely out of the prismatic spectrum. Hence it follows, that the change is produced, not merely by the colorific rays, but by rays which are incapable of rendering objects visible, or of producing any sensible heat. Thus we learn that the solar light contains at least two distinct sets of rays, one set which renders bodies visible, and another which blackens muriate of silver, and reduces metallic oxides. This second set may be called *deoxidizing* rays, till some better name is thought of. They are obviously more refrangible than the colorific rays.

Such are the properties of light. They are sufficient to induce us to believe that it is a *body;* but it possesses three peculiarities, by which it is distinguished from all the substances hitherto described. It has the power of exciting in us the sensation of vision; it always moves with a prodigious velocity, and the particles of it are never found cohering together in masses. This last property cannot well be accounted for, unless we suppose that its particles *repel* each other.†

The sources of light are, the *sun* and *stars*, *combustion*, *heat*, and *percussion*.

The light emitted by the sun is familiarly known by the name of the *light of day*. In all cases of rapid combustion, light is emitted: but different substances vary very much in the quantity of light which they give out while burning. All substances, except *gases*, become luminous when heated to a certain temperature (about 700°). They are then said to be red hot. When hard substances, as two quartz stones, flint and steel, are struck against each other, luminous sparks are emitted. This is sometimes (as in the case of flint and steel) owing to the particles given off catching fire; but in other cases, the appearance of the spark has not been accounted for.

CHAP. II.

Of Caloric.

The meaning of the word *heat* is so well understood, that any attempt to define it is unnecessary. When we say that *a person feels heat*, that *a stone is hot*, the expressions are understood readily. Yet in each of these propositions, the word *heat* has a distinct meaning. In the first it signifies the *sensation of heat;* in the second, the *cause* of that sensation. To avoid the supposed ambiguity of these two meanings to one word, the term *caloric* was invented to signify the *cause of heat*. When I put my hand on a hot stone, I experience a certain sensation, which I call the *sensation of heat;* the *cause* of this sensation is *caloric*. The phenomena of heat, which are of the utmost importance in chemistry, will be treated of in the following sections.

SECT. I. *Of the Nature of Caloric.*

Two opinions respecting the nature of caloric have divided philosophers. According to some, like *gravity*, it is merely a property of matter, while others consider it as a peculiar substance. The latter opinion was first broached by the chemists, and is at present acceded to by almost the whole body of philosophers. A recent discovery of Dr Herschel has rendered this opinion, if possible, still more plausible than before.

Dr Herschel, while employed in examining the sun by means of telescopes, thought of examining the heating power of the different rays separated by the prism. He found that the most refrangible rays have the least heating power, and that the heating power gradually increases as the refrangibility diminishes. The *violet* ray of course has the least, and the *red* ray the greatest heating power. It struck Dr Herschel as remarkable, that the illuminating power and heating power follow different laws. The illuminating power is greatest in the middle of the spectrum, but the heating power is greatest at the *red* end. This led him to suspect, that the heating power does not stop at the end of the spectrum. On trying the experiment, he found that a thermometer placed a little beyond the spectrum rose still higher than when in the red ray. This important experiment was successfully repeated by Sir Henry Englefield. Hence it follows, that there are rays emitted from the sun which produce heat, but have not the power of illuminating: consequently caloric is emitted from the sun in rays, and the rays of caloric are not the same with the rays of light.

All the illuminating rays have the power of exciting heat. It is probable that they derive this power from rays of caloric mixed with them; for the rays from the moon, though they consist of the seven prismatic rays, do not, even when concentrated, affect the most delicate thermometer.

Thus it appears that solar light is composed of three sets of rays, the *colorific*, the *calorific*, and the *deoxidizing*.‡

The rays of caloric are refracted and reflected precisely as the rays of light. They obviously move with a very considerable velocity, though what that velocity is we do not at present know. It has been ascertained that caloric produces no sensible effect upon the weight of bodies; the weight remaining sensibly the same, whether a substance be hot or cold. In this respect it agrees with light. It agrees with light also in another property, its particles are never found cohering together in masses.

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* In the common red cabbage, a plant so closely compacted together, we may reasonably suppose the internal leaves to be equally secluded from light, as if buried beneath the earth; but we find them equally red with those externally situated; why is this, if the coloration of plants is dependent on light alone? why are any found variegated, even on the same flower, and why are any to be found of a perfect white colour? COXE.

† If its particles repel each other, can this repulsion be ascribed to caloric? If not, then caloric is not the only principle of repulsion of bodies. *Ibid.*

‡ It is yet to be proved beyond the possibility of doubt, that light and heat do actually emanate from the sun; we do not imagine the electric fluid comes from the cushion of the machine, although this is a *sine qua non* of its appearance, in a state of freedom from its state of quiescence. COXE.

Sect. II. *Of the Motion of Caloric.*

When heat radiates from the surfaces of bodies, it moves with great velocity; but, when it makes its way through bodies, it moves comparatively slowly. Let us consider these two kinds of motions.

1. *Escape of Heat from Surfaces.*

When bodies, artificially heated, are exposed to the open air, they emit heat, and continue to do so till they sink to the temperature of the surrounding atmosphere. The rapidity of their cooling depends upon the nature of their surface. For the investigation of this branch of the subject, we are indebted chiefly to the sagacity of Professor Leslie. A globe of bright tin, filled with hot water, lost a certain number of degrees of heat in 156 minutes. But, when covered with a thin coat of lamp-black, it lost the same number of degrees in 81 minutes. The rate of cooling was likewise increased by covering it over with a coat of linen, and by painting it with black or white paint. This difference is only conspicuous in still air. In a strong wind it diminishes, or nearly disappears.

When a canister of tin, filled with hot water, is placed before a concave mirror of bright polished tin, having a delicate thermometer in the focus, the thermometer experiences a certain elevation. The *differential* thermometer, invented by Mr Leslie, answers best for these experiments. It consists of a small glass tube, bent into the shape of the letter U, and terminating at each extremity in a small hollow ball. The tube is filled with sulphuric acid, tinged red with carmine. An ivory scale is affixed to one of the legs, and the top of the liquid stands at the division of the scale marked 0. This thermometer is not affected by any change in the temperature of the room. But if one of its balls be heated, while the other is not affected, the air within it expands and pushes away the sulphuric acid, which rises in the other leg. Hence it indicates changes of heat in a particular point, as the focus of a mirror. The ball of it which is applied to the point, and undergoes the change, is called the *focal ball.*

When the experiment is made in the way above specified, the rise of the thermometer depends upon the distance of the canister from the mirror, being always the greater the nearer the canister is to the mirror. From Mr Leslie's experiments it follows, that the effect on the thermometer is very nearly inversely proportional to the distance of the canister from the reflector.

When the nature and position of the canister is the same, the rise of the thermometer is always proportional to the difference between the temperature of the hot canister and that of the surrounding air.

Heat radiates from the surfaces of hot bodies in all directions, but the radiation is most copious in the direction perpendicular to the surface of the hot body.

When different bodies are applied in succession to the surface of the canister, their power of radiation becomes evident, by the effect they produce upon the thermometer. The following Table exhibits this effect, as ascertained by the experiments of Mr Leslie.

Lamp-black,	100°
Water, by estimate,	100+
Writing paper,	98
Rosin,	96
Sealing wax,	95
Crown glass,	90
China ink,	88
Ice,	85
Minium,	80
Isinglass,	80
Plumbago,	75
Tarnished lead,	45
Mercury,	20+
Clean lead,	19
Polished iron,	15
Tin-plate,	12
Gold, silver, copper,	12

Thus it appears that metals radiate heat worst, and that lamp-black, paper, and glass, are among the best radiators of it tried. The radiating power of the metals is increased by tarnishing and by scratching their surface.

The radiating powers of these bodies were ascertained by applying thin coats of them to the surface of the canisters. Now, it appears that the radiating power increases somewhat with the thickness of the coat, till that coat amounts to the $\frac{1}{1000}$ of an inch, when it remains stationary. But this does not hold with respect to metallic bodies, the thinnest coat of which produces as great an effect as the thickest.

When the focal ball of the thermometer is glass, let us suppose that it rises 100°. If we coat it with tin-foil, the rise will be reduced to 20°. Hence it follows, that those bodies that radiate heat best imbibe it best, and that those which radiate worst imbibe worst.

The contrary holds with respect to reflectors; those substances reflect *best* which radiate *worst*, and *vice versa*. The following Table exhibits the comparative goodness of different substances as reflectors, according to Mr Leslie's experiments.

Brass,	100
Silver,	90
Tin-foil,	85
Block-tin,	80
Steel,	70
Lead,	60
Tin-foil, softened by mercury,	10
Glass,	10
Ditto, coated with wax or oil,	5

When the polish of the reflector is destroyed by rubbing it with sand paper, the effect is very much diminished.

Radiation takes place only in elastic mediums. It is destroyed altogether by plunging the apparatus under water. It is nearly the same in air and in hydrogen gas, and does not seem to be affected by the nature of the elastic medium. It is diminished by rarefying the surrounding air.

When a substance is interposed between the hot canister and the reflector by way of screen, the effect is varied by its distance from the canister, by its thickness, and by the nature of its surface. The nearer it is to the canister, the less is the radiation affected; at a certain distance all radiation is destroyed. The thinner the screen, the less of the heat is interrupted; the radiation slowly diminishes as the thickness of the screen increases.

When the surface of the screen radiates heat well, the radiation is much less interrupted than if it radiate heat ill. Thus, if the screen be glass, the thermometer still rises a certain number of degrees, but if it be tin-foil the thermometer does not rise at all. From these phenomena it cannot be doubted that the screen, in all cases, intercepts the whole of the heat, that it becomes hotter itself, and then radiates heat from its surface.

Such are the phenomena of the radiation of heat as far as they have been investigated. It follows very different laws from light in its radiation. Mr Leslie has endeavoured to show, that heat is not in reality radiated, but that it is propagated with the velocity of sound by means of undulations or pulses of air. This opinion he has supported with much ingenuity. But as he has brought no other evidence for its truth, but its convenience in explaining the phenomena, and as it is at variance with the direct experiments of other philosophers, it cannot be admitted till direct evidence be brought forward in support of it.

2. *Passage of Caloric through Bodies.*

Caloric, we have seen, is incapable of radiating through solid bodies, yet it is well known that all bodies are pervious to it. Through them, then, it must make its way in a different manner. In general it passes very slowly through them, and when it passes in this way, it is said to be conducted through them.

Bodies seem to conduct heat in consequence of their affinity for it, and of the property which they have of combining with an indefinite number of doses of it. Hence the reason of the slowness of the process. Hence also the reason why the temperature of the body through which it passes diminishes equally as we advance from the source of heat to the other extremity.

Bodies vary in their power of conducting heat. The metals are the best conductors of heat of all known bodies. From the experiments of Ingenhousz it follows, that silver and gold are the best conductors among the metals. Copper and tin follow next in order, and platinum, iron, steel, and lead, are nearly equal among themselves, but much inferior to the others. Stones come next after the metals, but they are greatly inferior to them. Bricks are still inferior to stones. Glass also is a bad conductor. Hence the facility with which it cracks when suddenly heated or cooled.

Dried woods are considerably inferior to glass. From the experiments of Meyer, it appears that they differ considerably among themselves. Charcoal is also a bad conductor. According to the experiments of Morveau, its conducting power is to that of fine sand as 2 to 3. Feathers, silk, wool, and hair are still worse conductors than any of the preceding substances. Hence the reason that they answer so well as articles of clothing.

It is admitted on all hands, that all solid bodies are conductors, for they allow heat to pass through them. Liquids also allow heat to pass through them. But they differ from solids in the mobility of their particles. When a particle of a liquid is heated, it becomes specifically lighter, and therefore rises. Count Rumford has endeavoured to prove, that heat passes through liquids only in consequence of the motion of their particles, and that if the particles of liquids were immoveable, heat could not pass through them at all. Hence he infers, that liquids are, in reality, non-conductors of caloric. But his experiments are not such as to warrant the conclusions he has drawn. The subject has been investigated by different chemists, with all the requisite care. It has been shown that heat can make its way downwards through liquids, in which case their particles cannot be supposed to move. Hence it follows, that they are all conductors. They are, however, very bad conductors. Water, for example, conducts heat much worse than any of the dry woods.

The gases are still worse conductors than liquids. They differ a good deal among themselves in their conducting power. Hydrogen gas appears to be the best, and carbonic acid the worst conductor. From the experiments of Leslie, it appears, that hydrogen conducts four times as well as common air. The conducting power of gases is diminished by rarefaction, by vapours of all kinds, and every thing which has a tendency to dilate air. The following Table by Mr Dalton, exhibiting the time taken by a thermometer to cool a given number of degrees in the different gases, will give the reader some idea of their relative conducting powers.

	Seconds.
Carbonic acid, ...	112
Sulphureted hydrogen, Nitrous oxide, . . . Olefiant gas, ...	100+
Common air, ... Oxygen, ... Azotic gas, ...	100
Nitrous gas, ...	90
Gas from pitcoal, . . .	70
Hydrogen gas, ...	40

SECT. III. *Of the equal Distribution of Temperature.*

When substances of different temperatures are placed in each other's neighbourhood, the hotter bodies become colder, and the colder acquire heat, and the changes continue till all the bodies acquire the same temperature. This property of caloric, of distributing itself equally, has been called the *equilibrium of caloric.* It might with more propriety be called the *equal distribution of temperature.*

It had been taken for granted by Sir Isaac Newton, and was proved by the experiments of Krafft and Richmann, that when a body is suspended in a medium of a temperature different from its own, the difference between the temperature of the body and the medium diminishes in a geometrical ratio, while the time increases in an arithmetical ratio; or, which comes to the same thing, that, in given small times, the heat lost is always proportional to the heat remaining in the body.

SECT. IV. *Of the Effects of Caloric.*

The changes which caloric produces on bodies may be arranged under three different heads; namely, 1. Changes in bulk; 2. Changes in state; and 3. Changes in combination.

1. *Changes in Bulk.*

Every addition or abstraction of heat produces a corresponding change in the bulk of the body affected. In general, the *addition* of heat produces *expansion,* and the *abstraction* of it produces a *diminution* of bulk. To this general law there are perhaps one or two exceptions.

The expansion of gases by heat is greatest, that of liquids much smaller, and that of solids smallest of all. Thus, 100 cubic inches of air by being heated from 32° to 212°, expand to 137.5 inches. The same augmentation of temperature makes 100 cubic inches of iron, by the same increase of temperature, expand only to 100.1 inches.

All gases undergo the same expansion by the same augmentation of temperature, and the same contraction by the same diminution of temperature. This change is nearly equable, though it is a little less at high temperatures than at low. From the most exact experiments hitherto made, we may conclude, that air and all gases expand about $\frac{1}{481}$ part of their bulk for every degree of heat thrown into them.

From the experiments of Gay Lussac, it appears that the steam of water and the vapour of ether undergo the same dilation as air, when the same addition is made to their temperature. Hence it is reasonable to conclude, that all elastic fluids expand equally and uniformly by heat.*

The expansion of liquids differs from that of elastic fluids, not only in quantity, but in the want of uniformity. Every liquid has a peculiar expansion of its own, different from that of every other liquid. The expansibility is greater when the temperature is high, than when it is low. Alcohol expands most of all the liquids hitherto tried; 100,000 parts of it at 32°, become 104,162 at 100°. Nitric acid is the next in order, then lintseed oil, then oil of turpentine, then sulphuric acid, then water, and mercury is the least expansible of all the liquids hitherto tried.

The solids expand much less than the liquids. As far as observation has gone, their expansion is equable, or at least their deviation from it is insensible. 100,000 parts of glass at 32°, become 100,083 at 212°. The order of the expansibility of the principal metals is as follows, beginning with the least expansible. Platinum, gold, antimony, cast-iron, steel, iron, bismuth, copper, brass, silver, brass-wire, tin, lead, zinc.

The property which bodies have of expanding when heat is applied to them, has suggested an instrument for measuring the relative temperatures of bodies. This instrument is the *thermometer*. A thermometer is a hollow tube of glass hermetically sealed, and blown at one end into a hollow globe or *bulb*. The bulb and part of the tube are filled with mercury. When the bulb is plunged into a hot body, the mercury expands, and of course rises in the tube; when it is plunged into a cold body, the mercury contracts, and of consequence sinks in the tube. Thermometers are made in this way. The requisite quantity of mercury being introduced, the thermometer is plunged into melting snow, and the place where the mercury stands is marked. This is called the *freezing point*. The thermometer is then plunged into boiling water, and the point at which the mercury stands marked. This is called the *boiling water point*. The distance between these two points is divided into a number of equal parts called degrees, and these degrees are continued indefinitely above and below these two points.

The thermometer gets its name according to the number of degrees into which the space between the freezing and the boiling point is divided. There are four thermometers still used in Europe. In that of Reaumur, the space between the two points is divided into 80°. The freezing point is marked 0, the boiling point 80°. In the thermometer of Celsius, the same space is divided into 100°.† The freezing point is marked 0, the boiling point 100°. This is the thermometer used in Sweden and in France since the revolution. In the thermometer of Fahrenheit, the space between the two points is divided into 180°. But the scale begins at the cold produced by a mixture of snow and salt, which is 32° below the freezing point. The freezing point is marked in consequence 32°, and the boiling point 212°. This is the thermometer used in Britain. It is the one always used in this article, except when some other is expressly mentioned. In the thermometer of Delisle, the space between the two points is divided into 150°, but the graduation begins at the boiling point, which is marked 0. The freezing point is marked 150.

As mercury does not expand equably, the thermometer does not give us an exact measure of the increase of heat. Mr Dalton has endeavoured to prove that mercury expands as the square of the temperature, reckoning from its freezing point. This opinion has induced him to construct a new thermometer, graduated according to that principle. If this opinion be correct, the common degrees are too large near the bottom of the scale, and too small towards the upper part of it. 122°, or half way between freezing and boiling, corresponds according to the new graduation with 110° of the old.

The exceptions to expansion by heat are of two kinds. 1. Those liquids which have a maximum of density corresponding with a certain temperature, and which of consequence expand whether they be heated or cooled beyond that temperature.

2. Certain liquids which become solid by cooling, and expand during the solidification.

Water is the only liquid at present known belonging to the first class. Its greatest density is at the temperature of 40°, or a little below it. If it be heated above that temperature it expands, and it expands equally if it be cooled below it. A vast number of experiments have been made upon this point, and there appears no doubt of the matter of fact. Mr Dalton has lately endeavoured to show, that 36° is the degree at which the density of water is a maximum, and his observations appear satisfactory. No satisfactory explanation of the cause of this singular anomaly has yet been offered.

The second class of bodies is numerous. Water expands with great force when it freezes, and is converted into ice. The specific gravity of ice is 0.92, that of water at 60° being 1.00. Hence, ice is lighter than even boiling hot water. It always, therefore, swims on the surface of the water. A similar expansion is observable during the crystallization of most of the salts. Among the metals there are three which expand in the act of congealing; these are *cast-iron*, *bismuth*, and *antimony*. All the rest seem to contract instead of expanding. Sulphur appears also to expand when it congeals. This expansion in these bodies must be ascribed to a new arrangement, which their integrant particles assume. It would lead one to suppose a kind of polarity in these integrant particles, otherwise it is difficult to conceive why they tend to expansion with so much force. Honey, oils, and most metals contract when they become solid. Sulphuric acid also appears to contract.

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* Although all elastic fluids expand equally and uniformly by heat, it does not appear to be proved by any thing but analogy, that they *all* owe their state of elastic fluidity to the agency of caloric. Coxe.

† Hence it is called the Centigrade thermometer. Coxe.

2. *Changes in the State of Bodies.*

All substances in nature, as far as we know them, occur in one or other of the three states, that of *solids*, of *liquids*, and of *elastic fluids*. In a vast number of cases, the same substance is capable of assuming each of these states in succession. Thus sulphur is usually solid, but at 218° it becomes a liquid, and at 570° it boils, and is converted into an elastic fluid. Water is a liquid, but at 32° it freezes into a solid, and at 212° it boils into an elastic fluid.

All solids (a very few excepted) may be converted into liquids, by heating them sufficiently; and almost all liquids, by cooling them sufficiently, may be converted into solids. The law then is, that solids by heat are converted into liquids and elastic fluids; while elastic fluids and liquids by cold are brought into the state of solids.

1. When solids are converted into liquids, the change in some cases takes place at once, without any perceptible interval between solidity and liquidity. In other cases, the solid passes slowly through all the intermediate degrees of softness, till at last it becomes a complete liquid. The melting of ice is an example of the first kind, that of wax and tallow of the second. This change takes place at a particular temperature, which is easily ascertained in the first class, but not so easily in the second. If the substance at the usual temperature of the atmosphere be liquid, this point is called the *freezing point;* but if it be usually solid, it is called the *melting point.*—Thus 32° is the *freezing point* of water, and 476° the *melting point* of bismuth.

Though 32° be the freezing point of water, it may be cooled down considerably below that point without freezing. In thermometer tubes, we have cooled it down to 7°, and in a wine glass to 20°. When agitated or touched with a bit of ice, it freezes very suddenly.*

The freezing point of water is lowered by dissolving different salts in it. Thus water saturated with common salt freezes at 4°, with sal ammoniac at 8°, with Rochelle salt at 21°, and with nitre at 26°. When the proportion of the same salt dissolved in water is varied, it follows from the experiments of Sir Charles Blagden, that the freezing point is always proportional to the quantity of the salt.

The nitric and sulphuric acids vary remarkably in their freezing points, according to circumstances. When much diluted with water, the weakest part freezes, while a strong portion remains liquid. When very much diluted, the whole freezes, and the freezing point is lower according to the proportion of acid present. The strong acids themselves undergo congelation, and each has a particular strength at which its congelation is the easiest. If it be stronger or weaker, more cold is necessary to congeal it. Sulphuric acid of the specific gravity 1.780 freezes at 46°. But if it be diluted with a little water, it requires a cold of—45°; the strongest sulphuric acid freezes at 1°. The strongest nitric acid freezes at—45.5°. When considerably weaker it freezes at—2°, and when still weaker at—27.7°.

We are indebted to Dr Black for the first satisfactory explanation of the change of solids into liquids by heat. According to him, solids, in order to liquify, combine with a quantity of heat which enters into them, and remains in them without increasing their temperature. Hence he called it *latent heat.* Liquids congeal by giving out this *latent heat.* This opinion is established by simple but satisfactory experiments, and he ascertained that the latent heat of water is 140°. The following Table exhibits the latent heat of some other liquids, as ascertained by the experiments of Dr Irvine:

	Latent heat	Ditto reduced to the specific heat of water.
Sulphur .	143.68	27.14
Spermaceti	145	
Lead . .	162	5.6
Beeswax .	175	
Zinc . . .	493	48.3
Tin . . .	500	33
Bismuth .	550	23.25

Dr Black has shown also, that the softness of such bodies as are rendered plastic by heat, depends upon their combining with a quantity of caloric.†

2. Thus the conversion of solids into liquids is owing to their combining with heat. There is another change no less remarkable, to which bodies are liable when exposed to the action of heat. Almost all liquids, when exposed to a certain temperature, gradually assume the form of an elastic fluid, possessing the properties of air. These fluids retain their elastic form as long as the temperature continues, but when cooled down they lose that form, and are converted into liquids.

Some liquids are gradually converted into elastic fluids at all temperatures, while others do not begin to undergo the change till heated to a certain temperature. Water and alcohol are well known examples of the first class of liquids; sulphuric acid, and the fixed oils, of the second. Water gradually evaporates, even when in the state of ice, but sulphuric acid not till heated above 212°. The first class of liquids are said to *evaporate* spontaneously.

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* The water thus cooled down to 7° or 25° below its freezing point, must evidently lose so many degrees of its latent heat, or caloric of fluidity: but how can this be satisfactorily explained on the common principles of latent heat; for, if water requires 140° of heat to keep it fluid, how can its fluidity still be maintained, when 25 of those degrees are absolutely abstracted from it? Coxe.

† From whence does ice in a sudden thaw acquire the 140° of heat necessary to its liquifaction? not from the surrounding bodies certainly, for they are equally augmenting in temperature, as well as the atmosphere! and where does the latent caloric of water escape to, in a cold winter's night, during its conversion into ice? The thermometer evinces, both in the atmosphere, and in all surrounding bodies, a loss of heat, perhaps of 20, 30, or 40°. Yet 140° of heat have escaped from the freezing water! Coxe.

When other circumstances are the same, the evaporation increases with the temperature, and the elasticity of the vapour, of course, increases in the same proportion. At a certain temperature this elasticity balances the pressure of the atmosphere. When that happens, if the heat be applied below, the liquid assumes the aërial form with great rapidity. The vapour forces its way through the liquid, and a violent agitation is the consequence. The liquid is then said to *boil*. Every particular liquid has a certain temperature at which it begins to boil. Thus, ether boils at 98°, alcohol at 174°, and water at 212°.

The boiling point varies with the pressure of the atmosphere. It is highest when the barometer is high, and lowest when it is low. All liquids boil in a vacuum about 145° lower than under the pressure of the atmosphere. The elasticity of vapour increases with the temperature. At 32° the vapour of water is capable of supporting a column of mercury 0.2 inches high; at 212° it supports a column of 30 inches.

Dr Black applied his theory of latent heat to the conversion of liquids into elastic fluids, and showed that it is owing to the very same cause as the conversion of solids into liquids, namely, to the combination of a certain dose of caloric with the liquid without any increase of temperature. From his experiments, compared with those of Mr Watt and Mr Lavoisier, it appears that the latent heat of steam is about 1000°.

Thus it appears that Dr Black's law is very general, and comprehends every change in the state of a body. It may be stated in its most general form as follows. *Whenever a body changes its state, it either combines with caloric, or separates from caloric.*[*]

3. It is probable that all elastic fluids, or gases, owe their elastic form, like steam, to the combined caloric which they contain; and that, if they could be subjected to a sufficient degree of cold, they would lose their elasticity, and be converted into liquids or solids. This has been done successfully to some gases; oxymuriatic acid and ammonia, for example, become liquid, when cooled down low enough. The experiment has not succeeded with other gases, even though subjected at once to cold and pressure.[†]

3. *Changes in Composition.*

Caloric not only increases the bulk of bodies and changes their state, but its action decomposes many compounds altogether, either into their elements, or it causes these elements to combine in a different manner. Thus, ammonia, in a red heat, is resolved into hydrogen and azotic gases; and alcohol, by the same heat, is converted into inflammable air and water.

In general, those compounds, which have been formed by combustion, resist the action of heat with considerable obstinacy. Those that contain oxygen, and which have been formed without combustion, are easily decomposed, and so are most of those that contain combustibles.

SECT. V. *Of the Quantity of Caloric in Bodies.*

This investigation naturally divides itself into two parts: 1. The *relative quantities* of heat in bodies, or the quantities in each necessary to produce a given change of temperature. This is usually termed *specific caloric*. 2. The *absolute quantity* of heat which exists in bodies.

1. *Of the Specific Caloric of Bodies.*

If equal weights of water and spermaceti oil be mixed at different temperatures, it is natural to expect that the mixture will acquire the mean temperature. Suppose the temperature of the water 100°, and that of the oil 50°, it is reasonable to expect that the water would be cooled down 25°, and that the oil would be heated 25°, and that the temperature after mixture would be 75°. But, if we make the experiment, we find the result very different. The temperature, after mixture, instead of 75°, is 83⅓°, consequently the water has lost only 16⅔, while the oil has gained 33⅓. If we mix together equal weights of water at 50°, and spermaceti oil at 100°, the temperature, after agitation, will be only 66⅓°, so that the oil has lost 33⅓, while the water has only gained 16⅔. This experiment demonstrates that the same quantity of heat does not produce the same effect on water and spermaceti oil. The quantity which raises water 16⅔, raises the oil 33⅓, or it produces double the effect upon the oil that it does on the water. If the other substances be tried in the same manner, we shall find that they all differ from each other in the quantity of caloric necessary to heat each of them a given number of degrees, some requiring more than the same weight of water would do, and others less. Now, the quantity necessary to produce this effect is called the *specific caloric* of each. The specific caloric of water is taken as the standard and called 1, and all the others referred to it. It is obvious, from the preceding example, that the specific caloric of water is double that of spermaceti oil. If we represent the first by 1, we must, of course, represent the second by 0.5.

This investigation was begun by Dr Black, and prosecuted by Dr Irvine and Dr Crawford, who published a table of the specific heat of various bodies, and made it the foundation of his explanation of animal heat. Mr Wilcke of Sweden likewise investigated the specific heat of various bodies. Lavoisier and Laplace attempted the investigation, by ascertaining how much ice given weights of bodies, heated a certain number of degrees, was capable of melting during the cooling. The subject was afterwards prosecuted by Kirwan, Meyer, Leslie, and Dalton. The following Table exhibits the result of all the experiments hitherto published on this important subject.

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[*] Of this, it is believed little doubt can be entertained, after reading Dr Black's highly interesting experiments on the subject; but from whence the body acquires the heat, or where it goes to, under the circumstances mentioned in the preceding note, are points I think not satisfactorily shewn. It appears to me explicable only on the supposition of caloric being a substance totally independent of the sun and other bodies; always existing around us in a quiescent state, unless called into action by causes to us probably unknown.

COXE.

[†] Although this position is probable as it respects some few of those bodies, yet with respect to others, particularly oxygen, nitrogen, and hydrogen gases, there is nothing but analogy to warrant it; and I cannot perceive, why the natural state of those substances should not be gaseous, independently of caloric, any more than that light, magnetism, and caloric itself, should possess their own peculiar forms of cohesion, (whatever they may be) independently of any other agent. *Ibid.*

I. *Gases.*

	Sp. Caloric.
Hydrogen	21.4000*
Oxygen	4.7490*
Common air	1.7900*
Carbonic acid	1.0454*
Azote	0.7936*

II. *Water.*

Ice	0.9000† 0.8000(a)
Water	1.0000
Steam	1.5500*

III. *Saline Solutions.*

Carbonate of ammonia	1.851† 0.95(D)
Sulphuret of ammonia (0.818)	0.994†
Sulphate of magnesia 1 Water 2	0.844†
Common salt 1 Water 8	0.832†
Ditto (1.197)	0.78(D)
Nitre 1 Water 8	0.8167‡
Nitre 1 Water 3	0646†
Carbonate of potash (1.30)	0.75(D)
Muriate of ammonia 1 Water 1.5	0.798†
Tartar 1 Water 237.3	0.765†
Sulphate of iron 1 Water 2.5	0.734†
Sulphate of soda 1 Water 2.9	0.728†
Alum 1 Water 2.9	0.649†
Nitric acid 9⅓ Lime 1	0.6189‡
Ditto (1.40)	0.62(D)
Solution of brown sugar	0.086*
Ditto (1.17)	0.77(D)

IV. *Acids and Alkalies.*

		Sp. Caloric.
Vinegar		0.92(D)
Nitric acid	pale	0.844†
	(1.20)	0.76(D)
	(1.2989)	0.6613‡ 0.62(L)
	(1.30)	0.66(D)
	(1.355)	0.576†
	(1.36)	0.63(D)
Muriatic acid	(1.122)	0.680†
	(1.153)	0.60(D)
Sulphuric acid	(1.885)	0.758‡
	(1.872)	0.429† 0.34(L)
	(1.844)	0.35(D)
	(1.87)	0.3345‡
		0.333(a)
Do. 4, Water 5		0.6631‡
Do. 4, do. 3		0.6031‡
Do. equal bulks		0.52(D)
Acetic acid (1.056)		0.66(D)
Potash (1.346)		0.759†
Ammonia	(0.997)	0.708†
	(0.948)	1.03(D)

V. *Inflammable Liquids.*

Alcohol		0.930(a)
		0.6666*
		0.64(L)
		0.602*
	(0.817)	0.70(D)
		1.086†
	(0.848)	0.76(D)
Sulphuric ether (0.76		0.66(D)
Oil of olives		0.718† 0.50(D)
Linseed oil		0.528‡
Spermaceti oil		0.5000* 0.52(D)
Oil of turpentine		0.472† 0.400(a)
Spermaceti		0.399†
Ditto fluid		0.320(a)

VI. *Animal Fluids.*

Arterial blood	1.0300*
Venous blood	0.8928*
Cow's milk	0.9999* 0.98(D)

VII. *Animal Solids.*

Ox hide, with hair	0.7870*
Lungs of a sheep	0.7690*
Lean of ox-beef	0.7400*

VIII. *Vegetable Substances.*

Pinus sylvestris	0.65¶
Pinus abies	0.60¶
Tilea Europæa	0.62¶
Pinus picea	0.58¶
Pyrus malus	0.57¶
Betula alnus	0.53¶
Quercus robur sessilis	0.51¶
Fraxinus excelsior	0.51¶
Pyrus communis	0.50¶
Rice	0.5060*
Horse beans	0.5020*
Dust of the pine-tree	0.5000*
Peas	0.4920*
Fagus sylvatica	0.49¶
Carpinus betulus	0.48¶
Betula alba	0.48¶
Wheat	0.4770*
Elm	0.47¶
Quercus robur pedunculata	0.45¶
Prunus domestica	0.44¶
Diospyrus ebenum	0.43¶
Barley	0.4210*
Oats	0.4160*
Pit-coal	0.28(D) 0.2777*
Charcoal	0.2631*
Cinders	0.1923*

* Crawford; † Kirwan; ‡ Lavoisier and Laplace; § Wilcke; ¶ Meyer; (L) Leslie; ‖ Count Rumford; (D) Dalton; (a) Irvine.

IX. *Earthy Bodies, Stone-ware, and Glass.*

	Sp. Caloric.
Hydrate of lime	0.40 (D)
Chalk	0.27 (D) 0.256*
Quick-lime	0.30 (D) 0.2229* 0.2168‡
Ashes of pit coal	0.1855*
Ashes of elm	0.1402*
Agate	0.195§
Stone-ware	0.195†
Crown-glass	0.200 (*a*)
Crystal	0.1929‡
Swedish glass	0.187§
Flint-glass	0.19 (D) 0.174†

X. *Sulphur*	0.19 (D) 0.183†
Muriate of soda	0.23 (D)

XI. *Metals.*

Platinum	0.13 (*a*)
Iron	0.143 (*a*) 0.13 (D) 0.125† 0.1269* 0.126§
Brass	0.1123* 0.116§ 0.11 (D)
Copper	0.1111* 0.114§ 0.11 (D)
Sheet-iron	0.1099‡
Gun-metal	0.1100‖
Nickel	0.10 (D)
Zinc	0.0943* 0.102§ 0.10 (D)
Silver	0.082§ 0.08 (D)
Tin	0.068† 0.0704* 0.07 (D) 0.060§
Antimony	0.086† 0.0645* 0.063§ 0.06 (D)
Gold	0.050§ 0.05 (D)
Lead	0.050† .0352* 0.042§ 0.04 (D)
Bismuth	0.043§ 0.04 (D)
Mercury	0.033† 0.0357* .0290‡ 0.0496 (D)

XII. *Oxides.*

	Sp. Caloric.
Oxide of iron	0.320†
Rust of iron	0.2500*
Ditto, nearly free from air	0.1666*
White oxide of antimony washed	0.220† 0.2272*
Ditto, nearly freed from air	0.1666*
Oxide of copper ditto	0.2272*
Oxide of lead and tin	0.102†
Oxide of zinc ditto	0.1369*
Oxide of tin nearly free from air	0.0990* 0.096†
Yellow oxide of lead ditto	0.0680* 0.068†

The specific heats of the gaseous bodies in the preceding table were ascertained by Dr Crawford, by means of very delicate experiments, made with every possible precaution to insure accuracy. Yet there is little probability that they are accurate. Nor are we in possession of any means of making them more so by experiment. Mr Dalton has calculated the specific heat of the different gases from theory. The following are the numbers he obtained. The specific heat of water, as usual, being 1.

Hydrogen gas	9.382
Azotic	1.866
Oxygen	1.333
Air	1.759
Nitrous gas	0.777
Nitrous oxide	0.549
Carbonic acid	0.491
Ammonia	1.555*
Carbureted hydrogen	1.333
Olefiant gas	1.555
Nitric acid	0.491
Carbonic oxide	0.777
Sulphureted hydrogen	0.583
Muriatic acid	0.424
Aqueous vapour	1.166
Ether vapour	0.848
Alcohol vapour	0.586

Dr Crawford supposed, that the specific heat of bodies is permanent while they retain their state. But Mr Dalton has lately endeavoured to prove, that it increases with the temperature of all bodies.

Dr Irvine ascertained, that the specific caloric always changes with the state of a body. When a solid becomes a liquid, or a liquid an elastic fluid, the specific caloric increases. When an elastic fluid becomes a liquid, or a liquid a solid, the specific heat diminishes.

The specific heat of bodies is increased by combining them with oxygen. Thus, the specific heat of metallic oxides is greater than that of metals, and of acids than of their bases.

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* Suppose Mr Dalton's calculations correct; the specific heat of hydrogen gas is 9.382
azotic gas 1.866

Then that of both is 11.248
But when these two bodies are combined as ammoniacal gas, we have the specific heat of only 1.555

So that a quantity of heat equal to 9.693
should be given out; a difference probably far greater than is warranted by experiment. The truth is, we know too little of the nature of caloric to form decisive opinions respecting it. Coxe.

2. *Of the Absolute Quantity of Caloric in Bodies.*

As the same quantity of heat produces different changes of temperature in different bodies, it is obvious, that the thermometer cannot indicate the absolute quantity of heat in bodies. Now, it becomes a question of considerable importance to inquire, if there be any method of ascertaining the absolute quantity of heat in bodies. Supposing a body deprived of all heat, and a thermometer applied to it, at what point would the thermometer stand?

Dr Irvine is the philosopher who first attempted to solve this problem. His reasoning was founded upon two suppositions. 1. That the specific heat was proportional to the absolute heat of bodies. 2. That the heat emitted or absorbed by a body, when it changes its state, is merely the consequence of the change which has taken place in its specific heat. Thus, when ice is converted into water, 140° of heat are absorbed; because the specific heat of water is so much greater than that of ice, that 140° are necessary to maintain the temperature. The first of these two suppositions gave him the ratio of the absolute quantity of heat in bodies, and the second, the difference between two absolute calorics. Thus, if the specific heat of water be 10, and that of ice 9, then the absolute quantity of heat in water is, to that in ice, as 10 to 9. Call the absolute heat of ice x, then that of water is $x+140$, and we have $x : x+140 :: 9 : 10$. Hence we get this equation, $10x=9x+1260$, which gives us $x=1260$. Water at 32° of course contains 1400° of caloric. Dr Crawford, from his experiments, stated the real zero at 1500 below 0; and Mr Dalton places it at 6000 below 0.

Unfortunately, the truth of the two suppositions upon which this ingenious reasoning is founded, cannot be admitted. We have no proof that the specific heat of bodies is proportional to their absolute heat. The second supposition is at variance with the mechanical phenomena which present themselves when substances change their state, and would leave that change itself unaccounted for. It cannot, therefore, be admitted. Various other methods of ascertaining the absolute heat of bodies have been proposed; but, as they are all unsatisfactory, it is not necessary to detail them here.

SECT. VI. *Of the Sources of Caloric.*

The most important sources of heat are the five following, the *sun*, *combustion*, *percussion*, *friction*, and *mixture*.

1. *The Sun.*

The sun is an immense globe, the diameter of which is 888,246 miles. It was long supposed to be in a state of violent combustion. But the curious observations of Dr Herschel render it probable that this notion is erroneous. From them it appears, that the sun is an opaque globe, surrounded by an atmosphere of great density and extent. In this atmosphere, there float two regions of clouds. The lowermost of the two is opake, and similar to the clouds which form in our own atmosphere; but the higher region of clouds is luminous, and emits the immense quantity of light to which the splendour of the sun is owing.

The sun emits three kinds of rays; the *calorific*, *colorific*, and *deoxidizing*. The first occasions *heat*, the second *colour*, and the third separates *oxygen* from various bodies.*

When the solar rays strike transparent bodies, they produce very little effect; but opake bodies are heated by them. They pass through transparent bodies; but are retained, at least in part, by opake bodies. The deeper the colour of the opake body, the greater is the heat produced. Black bodies are most heated, and white least, and the others in proportion to the intensity of the colour. The temperature produced in bodies by the direct action of the sun's rays, seldom exceeds 120°. But when the heat is prevented from escaping, as, by enclosing a thermometer within a glass vessel whose bottom is cork, the temperature sometimes rises nearly to 240°. When the sun's rays are accumulated by means of burning glasses, the most intense heat is produced that it is possible to raise by any known method.

2. *Combustion.*

Few phenomena are more wonderful or interesting than *combustion*. When a stone or a brick is heated it undergoes no change, and, when left to itself, it soon cools again, and becomes as at first. But when combustible bodies are heated to a certain degree in the open air, they suddenly become much hotter of themselves, continue for a certain time intensely hot, and send out a copious stream of light and heat. When this ceases, the combustible has undergone a most complete change, being converted into a substance possessed of very different properties, and no longer capable of combustion.

The first ingenious attempt to explain combustion was by Dr Hooke. According to him, there is an ingredient in air capable of dissolving combustibles when their temperature is sufficiently raised. The solution takes place with such rapidity, that it occasions light and heat, which, in his opinion, were mere motions. The quantity of this solvent in air is not great. Hence the reason why so great a proportion of air is necessary to support combustion. This hypothesis was embraced by Mayow, but without making any great addition either to its evidence or probability.

Beccher and Stahl soon after advanced another, which was much more universally embraced. According to them, all combustible substances contain in them a certain body called *phlogiston*, to which they owe their combustibility. This substance is the same in all combustible bodies. They owe their diversity to other ingredients combined with the phlogiston. During the combustion, the phlogiston separates, and the incombustible ingredients remain behind. The light and the heat are occasioned by the violent motion into which the phlogiston is thrown during its emission.

Light being considered as a body, occasioned a change in the Stahlian theory. Phlogiston was considered as nothing else than light fixed in bodies. When heat, in consequence chiefly of the discoveries of Dr Black, came to be considered as a body, the opinion respecting phlogiston got a new modification. It was considered as a subtile fluid, the same with the *ether* of Hooke and

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* It appears to me that this emission of three kinds of solar rays, is altogether hypothetical; and rests more on the convenience it affords of explaining certain phenomena, than on any decisive experiments. COXE.

Newton, which occasioned gravity, and gave the bodies, called *heat* and *light*, the peculiar motions which produce in us the sensations of heat and light.

Dr Priestley first attempted to account for the necessity of air for combustion. Air, according to him, has an affinity for phlogiston; it draws it out of the combustible body, and combines with it. But if so, whence come the heat and the light, which make their appearance in all cases of combustion?[*] According to Dr Crawford, they existed in the air, and were displaced by the phlogiston when it united with that fluid.

These modifications of the Stahlian theory were evidently improvements. But they left the nature of phlogiston altogether out of view. Kirwan first attempted to ascertain what this substance was, and to prove it the same with what is now called *hydrogen gas*. This opinion he supported in an ingenious Essay on *Phlogiston*; and it was embraced by many of the most respectable chemists in Europe.

Meanwhile, Mr Lavoisier had been investigating the subject with the minutest attention, and, after a very long, elaborate, and ingenious examination, had satisfied himself, that, in every case of combustion, oxygen unites with the burning body.[†] For a long time nobody would accede to his opinion; but at last, in 1785, Berthollet and Fourcroy joined him, and soon after Guyton Morveau came over to his sentiments. They wrote a refutation of Mr Kirwan's essay, which was so satisfactory, that Mr Kirwan himself came over to their opinion. And after a short, but pretty violent controversy, the Lavoisierian theory of combustion was universally adopted. According to this theory, combustion consists of two processes, a *combination* and a *decomposition*. The oxygen of the air *combines* with the combustible, and gives out the *heat* and *light* with which it was previously *united*.

The following observations may, perhaps, contribute somewhat to elucidate what is still obscure in this curious process.

All bodies, as far as combustion is concerned, may be divided into *supporters*, *combustibles*, and *incombustibles*. By supporters, are meant certain bodies, not indeed capable of burning, but combustion cannot go on without their presence. *Air*, for example, is a supporter. *Combustibles* and *incombustibles* require no explanation.

Oxygen and chlorine are the only simple supporters known. When they combine with an incombustible, they form a compound supporter. The following are all the supporters at present known:

1. Oxygen.
2. Chlorine.
3. Air.
4. Nitrous oxide.
5. Nitrous gas.
6. Nitric acid.
7. Euchloric gas.

The combustibles are either the simple substances which have been already described, or combinations of these with each other, or with oxygen without combustion; in which last case, they may be called combustible oxides.

During combustion, the oxygen or chlorine of the supporter always combines with the combustible, and forms with it a new substance, which may be called a *product* of combustion. Now every product is either, 1. Water; 2. An acid; or, 3. A metallic oxide.

Some products are capable of combining with an additional dose of oxygen. But this combination is never attended with combustion, and the product, in consequence, is converted into a supporter. Such compounds may be called *partial supporters*, as a part only of the oxygen which they contain is capable of supporting combustion.

Since oxygen is capable of supporting combustion only in the supporters and partial supporters, it is clear that it is in a different state in these bodies from what it is in products. It is probable that, in supporters, it contains combined with it a considerable quantity of heat, which is wanting in products.

It is probable, that combustible bodies contain light as a constituent.[‡] For the quantity of light emitted during combustion depends upon the combustible; while the heat seems, in some measure at least, to depend upon the oxygen. If these two suppositions be admitted, the phenomena of combustion admit of an easy explanation. The base of the oxygen and of the combustible combine together, and form the product; while the heat of the one and the light of the other in like manner unite, and fly off in the form of fire.

3. *Percussion.*

It is well known, that heat is produced by the percussion of hard bodies against each other. Iron may be heated red hot by striking it with a hammer, and the sparks emitted by flint and steel are well known.

This evolution of heat appears to be the consequence of the permanent or temporary condensation of the bodies struck. Iron and most metals become specifically heavier when hammered. Now condensation always evolves heat. When air is condensed, it gives out a considerable quantity of heat, sufficient to set fire to tinder. When muriatic acid gas is passed through water, it is condensed, and the water becomes hot. On the other hand, when air is rarefied, it becomes suddenly much colder.

It is not difficult to see why condensation evolves heat. The particles being forced nearer each other, the repulsive force of the heat is increased, and a portion in consequence is driven off.[§] The specific caloric of bodies is diminished by condensation. Now the specific caloric can scarcely be conceived to diminish without the body giving out heat.

A part of the heat which follows percussion, is often owing to another cause. By the percussion, the heat of the body is raised so high, that combustion commences, and this occasions a still farther increase of the heat. It is in this way that sparks are produced when flint and steel are struck. The sparks are small pieces of the steel which have taken fire and melted during their passage through the air.*

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[*] Whence come the heat and light, which make their appearance when *incombustible* bodies are heated to ignition? Not from the atmospheric oxygen, for this is presumed to be inactive; nor from the fuel, for the incombustible will remain ignited long after being removed from that source. Coxe.

[†] Not in *every* case, if the doctrine of chlorine as advocated by the editors of this work, is correct. *Ibid.*

[‡] It does not seem probable to me, for the following reason; that alcohol is tinged, in its combustion, of a carmine hue by strontites; now strontites is an incombustible; and it is not contended that the light comes from it. How then can it, on the common view taken, afford a peculiar colour to the burning alcohol? Coxe.

[§] Mr Davy, in my opinion, justly considers this as a very rude mechanical explanation. *Ibid.*

4. *Friction.*

Heat is not only evolved by percussion, but also by friction. And not only by the friction of hard bodies, but even of soft bodies, as when the hand is rubbed against the sleeve of the coat. No heat has ever been observed from the friction of liquids.

The heat evolved by friction seems to be owing to the same cause as that by percussion; namely, a condensation of the substances rubbed. This condensation is, in some cases, permanent; but when the bodies rubbed are soft, it can only be momentary.

The heat evolved by friction is sometimes very considerable. Thus Count Rumford boiled water by the heat evolved by rubbing a steel borer against a cylinder of gun-metal. Probably in this case the density of the metal was a little increased. A very small increase would account for the whole heat evolved.† .

5. *Mixture.*

In a great number of cases, a change of temperature takes place when bodies combine chemically with each other. Sometimes the compound becomes colder than before, and sometimes hotter.

When Glauber's salt in crystals pounded is dissolved in water, a considerable degree of cold is produced; and the cold is still more intense, if the salt be dissolved in muriatic acid. If muriate of lime, in powder, and dry snow be mixed together, so great a degree of cold is produced, that mercury may be frozen if it be surrounded by such a mixture. Potash and snow produce an equally great cold. When nitric acid or sulphuric acid is poured upon snow, the snow dissolves, and an intense cold is produced.

On the other hand, when sulphuric acid and water are mixed, so great a heat is evolved, that the liquid is considerably hotter than boiling water. Heat also is produced, when nitric acid and water, or water and alcohol, are mixed together. Heat also is produced, if Glauber salt, in a state of efflorescence, is dissolved in water. An intense heat is produced by dissolving quick-lime in sulphuric acid.

In most of these cases of change of temperature, water is either one of the substances combined, or it forms an essential constituent of one of them. The heat or the cold produced, depends often on this constituent. Thus Glauber's salt, containing its water of crystallization, produces cold when dissolved; while the same salt, deprived of its water of crystallization, produces heat. If the new compound be more fluid than the two constituents of it, the temperature sinks; if it be less fluid, the temperature rises. Thus, when snow and common salt are mixed, they gradually melt and assume the form of a liquid, and the temperature sinks to zero. Solid water cannot become liquid, without combining with a quantity of heat; and the same rule applies to all solid bodies which become liquid. Hence the cold evolved in these cases. The water of crystallization in Glauber's salt is solid: it becomes liquid when the salt is dissolved. Hence the cold produced. When the same salt, free from its water of crystallization, is thrown into water, it first combines with a portion of the water, and renders it solid. Hence the heat evolved.‡ Dr Black's doctrine of latent heat affords a satisfactory explanation of these phenomena.

When the density of two liquids united is greater than the mean, heat is evolved, because the specific caloric of the new compound is less than that of the constituents. This was first observed by Dr Irvine, and it accounts for the heat evolved, when water is mixed with sulphuric acid, nitric acid, or alcohol.

Thus it appears, that the changes of temperature produced by mixture, are either occasioned by the change of state which the water undergoes, or by a diminution of specific caloric, in consequence of the new combination.

BOOK II.

OF COMPOUND BODIES.

Compound bodies are substances composed of two or more simple substances united together. They amount to several thousands; but the present state of the science does not permit us to give an account of them all under their proper heads.

Compound bodies are of two kinds. Some are formed by the combination of two or more simple substances with each other; while others are formed by the union of two or more compound bodies with each other. To the first class belong *phosphoric acid*, composed of phosphorus and oxygen; and *ammonia*, composed of azote and hydrogen. To the second class belongs *phosphate of ammonia*, composed of phosphoric acid and ammonia. The first of these sets we shall call *primary compounds;* to the second we shall give the name of *secondary compounds.*

DIVISION I.

OF PRIMARY COMPOUNDS.

THE primary compounds, such of them at least as we are sufficiently well acquainted with to introduce here, may be arranged under the following heads:

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* Sparks may be given off by striking briskly together, two pieces of incombustible quartz; how will the above explanation accord in this case? COXE.

† It is barely probable; I might perhaps be warranted in saying it was impossible; for we must conclude the heat thus elicited, would produce its common effect of expansion in the metal; which is incompatible with any idea of increased density. *Ibid.*

‡ We will admit the truth of this explanation for an instant, and suppose the effloresced salt to consolidate its full portion of water of crystallization, by which its caloric of fluidity is given off. But the salt thus perfect, by its solution, must have that water of crystallization almost immediately restored again to a fluid state; in passing to which state, it must necessarily re-absorb its caloric of fluidity; and the solution ought to be found of the original temperature; but as this is not the fact, there is good reason to doubt the explanation given, and the support it either receives from, or gives to, Dr Black's doctrine of latent heat. COXE.

1. Alkalies.
2. Earths.
3. Oxides.
4. Acids.
5. Compounds of chlorine.
6. Compound combustibles.

These shall be the subject of the six following Chapters.

Chap. I.

Of Alkalies.

The term *alkali* was introduced into chemistry, after having been applied to a plant that still retains the name of *kali*. When this plant is burnt, the ashes washed in water, and the water evaporated to dryness, a white substance remains, called *alkali*. Alkali may be obtained from many other bodies besides this plant. Chemists gradually discovered that different substances had been confounded together under the name of alkali. The word, in consequence, became general, and is now applied to all substances having the following properties.

1. A caustic taste.
2. Volatilized by heat.
3. Capable of combining with acids, and of destroying their acidity.
4. Soluble in water, even when combined with carbonic acid.
5. Capable of converting vegetable blues to green.

The alkalies at present known are three in number: 1. Ammonia; 2. Potash; 3. Soda. The first is called *volatile alkali;* the two last *fixed alkalies*.

Sect. I. *Of Ammonia.*

Put into a retort a mixture of three* parts quick-lime, and one part sal-ammoniac; plunge the beak of the retort into a trough filled with mercury. Apply heat. A gas comes over, which may be received in glass jars filled with mercury. This gas is *ammonia*.

This gas possesses the mechanical properties of common air. Its taste is acrid and pungent, and it has a strong smell, not unpleasant when diluted. Animals cannot breathe it, and combustibles do not burn in it. Its specific gravity is 0.600, that of air being 1.000. At the temperature of 60°, 100 cubic inches of it weigh 18.16 grains. When exposed to a cold of —45°, it is condensed into a liquid. When passed through a red-hot tube, it is decomposed and converted into hydrogen and azotic gazes.

Water absorbs it with great rapidity. This liquid absorbs 780 times its bulk of this gas; and six parts of water, by this absorption, increase in bulk to 10 part The specific gravity of this solution is 0.900. It is in this state that ammonia is commonly used. It was known to the alchymists, and called *hartshorn*, *spirit of urine*, and *spirit of sal ammoniac*.

Ammoniacal gas is not altered by light, but when electric sparks are made to pass through it, its bulk is nearly doubled, and it is converted into hydrogen and azotic gases. Hence it follows, that it is composed of hydrogen and azote. The most exact experiments make the proportion of the constituents, three parts, in bulk, of hydrogen gas, and one part of azote; or in weight,

81.5 azote,
18.5 hydrogen.

100.0

When mixed with oxygen gas, it detonates by electricity, and is decomposed, as Dr Henry has ascertained. To analyse ammonia by means of oxygen, it ought to be first mixed with half its bulk of oxygen gas. An electric spark occasions a combustion; but the whole of the hydrogen is not consumed. By adding another quantity of oxygen gas, a new combustion may be produced. Double the oxygen gas consumed indicates the bulk of hydrogen, and the azote remaining in the residuary gas, its bulk may be estimated.

When mixed with chlorine, it burns with considerable splendour; and a quantity of sal-ammoniac is formed at the same time.

Sulphur is the only one of the simple combustibles that combines with ammonia. The combination may be produced by mixing it with sulphur in the state of vapour, or better by distilling a mixture of equal weights of sal-ammoniac, sulphur, and quick-lime diluted with a little water. A yellow liquid comes over, which consists of water, holding in solution ammonia and sulphur. It contains an excess of ammonia.

When ammonia comes in contact with phosphorus at a red heat, it is decomposed, and phosphureted hydrogen gas formed. When ammoniacal gas is made to pass through red-hot charcoal, a substance is formed called *prussic acid*.†

Ammonia is not acted on by azote.

Ammonia is capable of oxidizing some of the metals, and of dissolving the oxides formed. Liquid ammonia dissolves the oxides of silver, copper, iron, tin, nickel, zinc, bismuth, and cobalt. When digested upon the oxides of mercury, lead, or manganese, it is decomposed, water formed, and azotic gas emitted. It combines readily with the peroxides of gold and silver; and forms two remarkable compounds, known by the names of *fulminating gold* and *silver*.

Fulminating gold may be obtained by dissolving gold in aqua regia, and precipitating it by ammonia. A yellow precipitate falls, which is to be washed and dried. It is fulminating gold It is composed of five parts yellow oxide of gold, and one part of ammonia. It fulminates violently, when heated to the temperature of about 300° or 400°, also when struck violently with a hammer, or when triturated in a mortar. Water is formed, and azotic gas emitted.

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* The lime in the above process being a very cheap article, it cannot from considerations of economy be of any consequence how much may be taken; but, when it is considered, that the greater the quantity of lime used, the larger must be the required retort, whether glass or iron be used, it may not be improper to state, that we have always found an equal weight of lime more than sufficient to expel the ammonia from the sal-ammoniac. If after the process is concluded, water be poured into the vessel, a large quantity of insoluble matter will remain, which on examination will be found uncombined lime, the water carrying off the muriate of lime formed during the process. Hembel, jun.

† If oxygen is the acidifying principle as maintained, from whence is it obtained in this process? If prussic acid contains any oxygen, it seems only capable of acquiring it from the nitrogen; I mean, if experiment proves nitrogen to be a compound of oxygen and hydrogen. The fact of the prussic acid being formed by the process above mentioned, is perhaps in favour of this position. Coxe.

Fulminating silver was discovered by Berthollet. It may be prepared by dissolving silver in nitric acid, precipitating by lime-water, drying the precipitate in a filter, and then keeping it for twelve hours in liquid ammonia. Its tendency to explode is so strong, that it is dangerous to prepare it except in small quantities.

If a globule of mercury be put into a hollow in a moistened piece of sal-ammoniac, and exposed to the energy of a powerful galvanic battery, it increases in bulk, and acquires the consistency of butter. Its specific gravity is reduced to 3. The mercury has obviously amalgamated with some metallic body. If this amalgam be thrown into water, the mercury resumes its original state, a little hydrogen gas is exhaled, and the water is impregnated with a weak solution of ammonia. Hence it would appear, that the amalgamating metal is the basis of ammonia; that it decomposes water, emits the hydrogen, and retains the oxygen; and that, by this combination, it is converted into ammonia. This unknown metallic basis of ammonia has been called *ammonium*.*

Sect. II. *Of Potash.*

Potash, called also *vegetable alkali*, is obtained from the ashes of trees, and of vegetables that grow at a distance from the sea-shore. These ashes are lixiviated with water; the water evaporated to dryness; the residual salt mixed with twice its weight of quick-lime, and a sufficient quantity of water to make the whole into a thin paste. The water is drawn off in 24 hours, boiled to dryness in a clean iron pot, and then mixed with a quantity of alcohol, equal in weight to half the original salt. The alcoholic solution, after standing some days in well-closed phials, is decanted off, and the alcohol distilled away in a silver still. The substance which remains behind is pure potash.

Potash is a brittle substance, of a white colour, and a smell like that which is perceived during the slacking of quick-lime. Its taste is extremely acrid, and it is very corrosive, destroying the texture of most animal and vegetable bodies to which it is applied. Its specific gravity is 1.7085.

When heated, it melts. At a red heat it evaporates in a white acrid smoke.

It contains about one-fourth of its weight of water, even after being exposed to a red heat. When exposed to the air, it speedily absorbs moisture, and runs into a liquid. At the same time, it combines with carbonic acid, for which it has a strong affinity.

Water dissolves twice its weight of potash. The solution is limpid and colourless, and almost of the consistency of an oil. It is in this state that potash is commonly used by chemists. When evaporated to the proper consistency, the potash crystallizes.

2. Potash does not combine with any of the simple combustibles, except sulphur. The combination takes place by simple trituration of the two substances in a mortar, or by fusing them in a crucible. This compound is called *sulphuret of potash*. It was formerly distinguished by the name of *hepar sulphuris*, or *liver of sulphur*. Its colour is brown; it is hard, brittle, and has a glassy fracture. Its taste is acrid and bitter, and it leaves a brown stain on the skin. It converts vegetable blues to green, and soon destroys them. When exposed to the air, it acquires a green colour, and emits the smell of sulphureted hydrogen. In this state it is a triple compound, being composed of sulphur, potash, and sulphureted hydrogen. The last ingredient is formed by the decomposition of the water absorbed from the atmosphere. It dissolves in water, and forms a greenish yellow solution. In this state it is called *hydrogureted sulphuret of potash*.

When liquid potash and phosphorus are heated in a retort, water is decomposed, and *phosphureted hydrogen* gas is formed and comes over. This gas possesses the curious property of taking fire when it comes in contact with the air.

3. Potash does not unite with azote.

4. Several of the metals, when kept in liquid potash, are oxidized, water being decomposed. This is the case with iron, zinc, and molybdenum; and probably also with tin and manganese.

Potash dissolves the oxides of lead, tin, nickel, arsenic, cobalt, manganese, zinc, antimony, tellurium, tungsten, molybdenum.

Mr Davy has lately succeeded in decomposing potash, and in showing that it is a compound of oxygen and a peculiar metal, to which he has given the name of *potassium*. The decomposition was accomplished by exposing potash to the action of the galvanic battery. The metallic base separated at the negative extremity, while oxygen was evolved at the other. More lately, Thenard and Gay Lussac have ascertained, that potash is decomposed, and potassium obtained, when it is made to come in contact with iron turnings heated to whiteness in a gun-barrel.

Potassium, the base of potash, possesses the following properties. It is white like mercury. At 50°, it is a soft malleable solid, which becomes imperfectly liquid at 60°, and perfectly so at 100°. While at 32°, it is hard, brittle, and crystallized in facets. It is not only lighter than water, but lighter than any known liquid.† Its specific gravity does not exceed 0.885. Its affinity for oxygen is very great. In the open air, it is covered with a crust of potash in a few minutes. When thrown upon water, it decomposes that liquid with rapidity; hydrogen gas, holding potassium in solution, is disengaged and takes fire, which occasions the combustion of the whole potassium.

When heated in a small quantity of oxygen gas, it loses its metallic appearance, and assumes a reddish brown colour. In this state it may be considered as a peroxide of potassium.

Chlorine sets potassium on fire, and converts it into muriate of potash.

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* As Mr Davy in his Elements of Chemical Philosophy concedes, that ammonia can only be resolved into hydrogen and azote, there can be no such metallic basis as ammonium. Hembel, jun.

† The editors tell us alcohol may be obtained of a specific gravity of 791; here then is one known liquid which is lighter than potassium; and ether is another, as it is capable of being made of a specific gravity of 632. Coxe.

It combines with phosphorus, and forms a phosphuret, which has the colour of lead, and remains solid at a heat little short of that of boiling water. In the open air it burns, and is converted into phosphate of potash.

It combines rapidly with sulphur by heat, and heat and light are emitted at the moment of combination. The sulphuret has a grey colour, and in the open air, is soon converted into sulphate of potash.

It combines and forms alloys with all the metals tried, but these alloys are soon destroyed in the open air, or in water, and the potassium converted into potash.

Potash, according to the experiments of Mr Davy, is composed of about 86 potassium,
14 oxygen.

100

According to Thenard and Gay Lussac, it is composed of 83.371 potassium,
16.629 oxygen.

100

Sect. III. *Of Soda.*

Soda, called also *fossil* or *mineral alkali*, is found in large quantities ready formed in the earth. It may be obtained also from the ashes of the different species of *salsola* and other marine plants. The process is the same as that for procuring potash.*

When pure, it has a very strong resemblance to potash in most of its properties.

Its colour is greyish white, and it agrees with potash in its taste, smell, and action on animal bodies. Its specific gravity is 1.336.

Heat produces the same effects on it as on potash. In the open air, it absorbs water and carbonic acid, but it does not become liquid as potash does. After assuming the state of a paste, it soon dries again, and crumbles to powder.

It dissolves in water like potash, and may be obtained crystallized. The action of oxygen, of the simple combustibles and incombustibles, is similar to their action on potash. The same remark applies to the metals and their oxides.

Like potash, it is a compound of oxygen and a peculiar metal, to which Mr Davy, the discoverer, has given the name of *sodium*. It may be decomposed precisely in the same way as potash.

Sodium is a white metal like silver, solid, but very malleable, and so soft, that pieces may be welded together, by strong pressure. At 120°, it begins to melt; and is completely fluid at 180°. It is not volatilized in a red heat strong enough to melt plate-glass. It conducts electricity and heat in the same manner as potassium. Its specific gravity is 0.9348.

Its affinity for oxygen is similar to that of potassium. When exposed to the air, it is soon covered with a crust of soda; but as that alkali does not deliquesce, the nucleus is not so soon destroyed as happens to potassium. Hydrogen gas does not dissolve it. Hence no combustion takes place when sodium is thrown upon water, though it rapidly decomposes that liquid.

When fused with dry soda in certain quantities, there is a division of oxygen between the soda and the base, and a protoxide of sodium is formed, of a deep brown colour. It is capable likewise of absorbing an additional dose of oxygen, and of forming a peroxide.

It burns like potassium in chlorine. It combines with phosphorus, sulphur, and the metals, like potassium. From the experiments of Mr Davy, it appears that soda is composed of Sodium 78
Oxygen 22

100

According to Thenard and Gay Lussac, it is composed of Sodium 74.63
Oxygen 25.37

100

Thus it appears, that the two fixed alkalies are metallic deutoxides. It is very probable that ammonia is likewise an oxide, though the metallic base of which it consists has not yet been obtained in a separate state.

Chap. II.

Of the Alkaline Earths.

The term *earth*, in chemistry, is applied to all substances possessing the following properties.

1. Insoluble in water, or at least becoming insoluble when combined with carbonic acid.†
2. Little or no taste or smell, at least when combined with carbonic acid.
3. Fixed, incombustible, and incapable, when pure, of being altered by the fire.
4. A specific gravity not exceeding 4.9.
5. When pure, capable of assuming the form of a white powder.
6. Not altered when heated with combustibles.

The earths have been divided into two classes, namely, *alkaline earths*, and *earths proper*. The alkaline are four in number, namely, *lime*, *magnesia*, *barytes*, *and strontian.*‡

Sect. I. *Of Lime.*

Lime has been known from the remotest ages. It abounds in every part of the earth, constituting immense ranges of rocks and mountains. It may be obtained by *burning* those crystallized limestones called *calcareous spars*, or certain white marbles. Oyster shells also, when burnt, yield it nearly pure.

Pure lime is white, moderately hard, but easily reduced to powder. Its taste is acrid like that of the fixed alkalies, and it in some measure corrodes those animal bodies to which it is applied. Its specific gravity is 2.3. It tinges vegetable blues green, and at last renders them yellow. It does not melt in the most violent heat that can be applied.

When water is poured upon it, the lime swells and falls to pieces, and so much heat is evolved as to evaporate a portion of the water, and even to set fire to combustible substances with which it happens to be in contact. This process is called *slacking* the lime. A portion of the water combines with the lime, and becomes solid. Hence the cause of the heat evolved.* Slacked lime is composed of 3 parts lime and 1 water. It has been called *hydrate of lime.*

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* It is largely obtained from muriat of soda, by means of some of the oxyds of lead, &c. Coxe.

† Some of them, as lime, are, however, rendered more soluble in water, by excess of carbonic acid. Coxe.

‡ The alkaline properties of these four, are so considerable, especially of the two last, that Fourcroy, and other writers, have, with great propriety, removed them altogether to the class of alkalies. *Ibid.*

The difference between *limestone* and *lime* was first ascertained by Dr Black. Limestone is lime combined with carbonic acid. By burning it, the carbonic acid is driven off, and the pure lime remains.

When lime is exposed to the open air, it gradually attracts moisture, falls to powder, and, becoming saturated with carbonic acid, soon resumes its original state of limestone.

Water dissolves less than 0.002 parts of its weight of lime. The solution is called lime-water. It is limpid, has an acrid taste, and changes vegetable blues to green. When exposed to the air, the lime soon combines with carbonic acid and precipitates, leaving the water pure. From the experiments of Mr Dalton, it appears that cold water dissolves twice as much lime as hot water.

Lime has the property of absorbing oxygen. Sulphur and phosphorus are the only two simple combustibles that unite with it.

Sulphuret of lime may be formed by mixing its two constituents together, and heating them in a crucible. The mass has a reddish colour. In the air it becomes greenish yellow, sulphureted hydrogen is formed, and the mass is converted into *hydrogureted sulphuret of lime.* This last compound may be formed by boiling a mixture of sulphur and lime in about ten times its weight of water. The solution has a yellow colour, and is used for absorbing oxygen from air.

Phosphuret of lime may be formed by passing phosphorus through red-hot lime in a glass tube. It has a deep brown colour, and falls to powder in the air. When thrown into water, bubbles of phosphureted hydrogen gas are emitted, which take fire as they separate from the liquid.

Lime does not unite with azote.

Lime facilitates the oxidizement of several of the metals. It dissolves some metallic oxides, as those of mercury and lead.

It does not unite with the alkalies.

Mr Davy has lately ascertained that lime, like the fixed alkalies, is a compound of oxygen and a peculiar metal, to which he has given the name of *calcium.* He decomposed lime, by exposing a mixture of moistened lime and red oxide of mercury to the action of a galvanic battery. A globule of mercury was placed in the middle of the mixture. The lime was decomposed, and its base united with the mercury, and formed an amalgam. The mercury was distilled off in glass tubes filled with the vapour of naphtha, and the *calcium* remained behind.

Calcium is white like silver, solid, and four or five times heavier than water. When heated, it burns brilliantly, and quick-lime is produced.

SECT. II. *Of Magnesia.*

Magnesia was discovered about the beginning of the 18th century, by a Roman canon. But little was known about its nature, till Dr Black made his celebrated experiments on it in 1755.

It may be procured from the salt called *sulphate of magnesia*, or *Epsom salt*, by dissolving the salt in water, and pouring potash into the solution. A white matter falls; when washed and dried it is pure magnesia.

Magnesia is a very soft light powder, with very little taste, and destitute of smell. Its specific gravity is 2.3. It tinges vegetable blues green. It does not melt in the strongest heat that can be raised.

It is not sensibly soluble in water, and has never been exhibited in a crystallized form. When exposed to the air, it attracts carbonic acid very slowly.

It does not combine with oxygen, nor with any of the simple combustibles except sulphur. The sulphuret of magnesia may be formed, by mixing the two constituents, and exposing it to a moderate heat. The result is a yellow powder slightly agglutinated.

It does not combine with azote.

It has no action on the metals, nor is it known to combine with any of their oxides. Neither does it unite with the fixed alkalies or with lime.

Mr Davy succeeded in decomposing magnesia, by the same process that furnished him with the base of lime. Like lime, it is composed of oxygen and a metal, to which the name of *magnium*† has been given. This metal is white, sinks rapidly in water, absorbs oxygen when exposed to the air, and is converted into magnesia. It decomposes water, but not nearly so rapidly as the other alkaline metals, owing doubtless to the insolubility of magnesia.

SECT. III. *Of Barytes.*

Barytes was discovered by Scheele in 1774. It is usually obtained from a heavy foliated brittle mineral, pretty common, and called *ponderous spar*, or *sulphate of barytes.* This mineral is mixed with charcoal powder, and exposed to a strong heat in a crucible. It is then dissolved in water, and saturated with nitric acid. The liquid, filtered and evaporated, yields crystals, which being exposed to a strong heat in a crucible, leave behind them an earthy matter, which is barytes.‡

Barytes thus obtained is a greyish white porous body, and may be easily reduced to powder. Its taste is more caustic than that of lime, and when swallowed it acts as a violent poison.§ Its specific gravity is 2.374. When water is poured on it heat is evolved, and the barytes is *slacked* precisely as happens to lime. By this means it combines with water, and is converted into *hydrate of barytes*.

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* If it depends on the extrication of caloric of fluidity, the water must be in a state of solidity far greater than it is in the form of ice. In this last case, 140° of heat are presumed to escape; but in the slacking of lime, the heat is capable of firing sulphur, which requires about 500°. COXE.

† Altered to magnesium by Mr Davy, in his *Elements of Chemical Philosophy.* COXE.

‡ In London, an elegant and permanent white, for water colours, is vended by the name of mineral white. It is said by Mr Grover Kemp, in Nicholson's *Journal*, vol. xxx, page 34, to be prepared, by dissolving pure or carbonated barytes in nitro-muriatic acid; filtering the solution, and adding thereto a solution of carbonate of ammonia as long as a precipitate appears. The precipitate is to be well washed in distilled water, and gradually dried by the fire. It is pure carbonate of barytes. HEMBEL, jr.

§ Sulphat of barytes is said not to be poisonous; if so, it probably arises from its great insolubility; hence, if by accident or design, barytes, or any of its soluble compounds should be taken into the stomach, the poisonous effects might be obviated by diluted sulphuric acid, with which an insoluble sulphat would be produced. The strong affinity of barytes to sulphuric acid, renders it the best test of the presence of that body. COXE.

Water dissolves about 0.05 of its weight of barytes. The solution has an acrid taste, and tinges vegetable blues green. Boiling water dissolves more than half its weight of barytes. As the solution cools, the barytes precipitates in crystals.

Barytes absorbs oxygen, but does not combine with any of the simple combustibles, except sulphur and phosphorus. The sulphuret and phosphuret of barytes may be formed precisely in the same way as those of lime, which they resemble in most of their properties.

Barytes is not acted on by azote.

Barytes has no action on the metals, but it combines with some of the metallic oxides, and forms compounds hitherto scarcely examined.

It does not combine with the alkalies, nor has it much action upon lime or magnesia.

Mr Davy has shown, that barytes, like the preceding earths, is a metallic oxide, being composed of oxygen and a metal, to which the name of *barium* has been given. The *barium* was obtained by the same process as that which furnished him the bases of lime and magnesia. It is a white solid metal, melts at a heat below redness, and is not volatilized at the temperature capable of melting plate-glass. It is at least four or five times heavier than water. It decomposes that liquid with great rapidity, and is converted into barytes. It undergoes the same change when exposed to the open air.

SECT. IV. *Of Strontian.*

Strontian was first discovered in the lead mine at Strontian in Argyleshire. It was suspected to be a peculiar earth by Dr Crawford in 1790, and its properties were soon after investigated by Dr Hope. Klaproth and Kirwan also ascertained its peculiarity. It is found sometimes combined with carbonic acid, sometimes with sulphuric acid. From the first compound, it may be obtained by making the mineral into a ball with charcoal powder, and exposing it to a violent heat; and from the second, by treating it precisely in the way described in the last Section for obtaining barytes.

Strontian thus obtained, is a porous mass of a greyish white colour. Its taste is acrid and alkaline, and it changes vegetable blues to green. Its specific gravity is 1.647. It is not poisonous.

When water is thrown upon it, the strontian becomes hot, combines with water, and is *slacked* like quicklime. It is soluble in water, 162 parts of that liquid taking up one part of strontian. Hot water dissolves a much larger quantity, and the strontian crystallizes as the solution cools.

Strontian does not combine with oxygen. The only simple combustibles that unite with it are sulphur and phosphorus. The sulphuret and phosphuret of strontian may be formed precisely as the same compounds of lime, and possess nearly similar properties.

Strontian does not combine with azote.

It has no action on the metals, but it combines with some of the metallic oxides. It does not unite with the alkalies, nor with the other alkaline earths.

It tinges flame of a beautiful red colour. The experiment may be made by setting fire to paper dipt in an alcoholic solution of muriate of strontian.*

Mr Davy has ascertained, that strontian, like the other alkaline earths, is composed of oxygen and a peculiar metal, to which he has given the name of *strontium*. This metal bears a close resemblance to *barium* in its properties.

CHAP. III.

Of the Earths Proper.

THE earths proper neither neutralize acids, nor produce any change on vegetable blues. They are five in number; namely, *alumina*, *yttria*, *glucina*, *zirconia*, *silica*.

SECT. I. *Of Alumina.*

Alumina may be obtained from the salt called *alum*, by the following process. Dissolve alum in water; pour ammonia into the solution, a precipitate appears; separate this precipitate and wash it; then boil it in liquid potash till the whole is dissolved; pour a solution of sal ammoniac into this liquid, a white matter precipitates, which, when washed and dried, is pure alumina.

Alumina is a white matter in powder. It has no taste, and when pure no smell. Its specific gravity is 2.000.

When heat is applied to alumina, it gradually loses weight, in consequence of the evaporation of moisture; at the same time its bulk is diminished. Alumina undergoes a diminution of bulk proportional to the heat to which it is exposed. Mr Wedgewood took advantage of this property, to contrive an instrument for measuring high temperatures. It consists of pieces of clay of a determinate size, and an apparatus for measuring their bulk with accuracy. One of these pieces is exposed to the heat, and the temperature is judged of by the contraction. This contraction is measured by means of two brass rules fixed to a plate. The distance between them at one extremity is 0.5 inch, and at the other extremity 0.3 inch. These rules are 24 inches long, and divided into 240 equal parts, called degrees. These degrees commence at the wide end of the scale. The first corresponds with 947° of Fahrenheit, or a red heat.

Alumina is not soluble in water, though it has a strong affinity for that liquid. It may be kneaded with it into a very ductile paste, possessed of a good deal of tenacity. Clay owes its ductility to the alumina which it contains. It retains water with more obstinacy than any of the other earths.

Alumina has no effect upon vegetable blues. It cannot be crystallized artificially, but it is found native in beautiful crystals, constituting the precious stone called sapphyr.

It neither combines with oxygen, nor with any of the simple combustibles. Azote has no action on it.

It does not unite with the metals, but it has an affinity for several metallic peroxides.

The fixed alkalies dissolve it readily when they are in a state of solution in water; but they do not melt with it when heated in a crucible. Barytes and strontian combine with alumina, both when heated with it in a crucible, and when boiled with it in water. It has a strong affinity for lime, and easily melts with it when it exceeds the lime in quantity; but when the lime exceeds, fusion does not take place. Magnesia and alumina have no action on each other.

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* And yet it is an incombustible body! how is this fact reconcilable with the idea of light in combustion, being derived either from the oxygen gas, or from the combustible? COXE.

It is probable that alumina, like the alkaline salts, is a metallic oxide. This notion was entertained long ago by chemists. Davy endeavoured to obtain the metallic basis by means of galvanism, but did not succeed, though he has rendered it probable that a metal exists in it. To this metal he proposes to give the name of *alumium*.

Sect. II. *Of Yttria.*

This earth was discovered by Gadoline in a Swedish mineral of a black colour, to which the name Gadolinite has been given. To obtain it, the mineral is reduced to powder, dissolved in nitro-muriatic acid, filtered, evaporated to dryness, redissolved, filtered, evaporated to dryness, the residual salt is heated to redness, redissolved in water, and ammonia poured into the solution. A white powder falls, which is yttria.

Yttria, thus procured, is a fine white powder without taste or smell. It has no action on vegetable blues. Heat does not melt it. Its specific gravity is 4.842.

It is insoluble in water, but, like alumina, it retains a portion of that liquid, though not with so much obstinacy.

It is insoluble in the liquid fixed alkalies; but it dissolves in carbonate of ammonia, and in all the other alkaline carbonates.

It does not combine with oxygen, the simple combustibles, or azote.

According to Ekeberg, when yttria is treated with muriatic acid, a quantity of chloric gas is formed. If so, it must contain oxygen, and of course be a metallic oxide. The opinion is probable, though no attempts have been made to decompose yttria by means of galvanism.

Sect. III. *Of Glucina.*

Glucina was discovered by Vauquelin in the two minerals called beryl and emerald. They are pounded and fused with thrice their weight of potash. The mass is dissolved in muriatic acid, and the solution evaporated to dryness. The residuum is digested in water, and thrown upon the filter. The liquid which passes through is mixed with carbonate of potash, and the precipitate dissolved in sulphuric acid. Sulphate of potash being added to the solution, it is laid aside for some time. Alum crystals gradually form. When no more appear, filter the liquid, add carbonate of ammonia in excess, filter again and boil the liquid for some time. A white powder precipitates, which is glucina.

Glucina is a soft white powder, without either taste or smell. It adheres strongly to the tongue, produces no change on vegetable blues, does not melt when heated, and does not harden and contract like alumina. Its specific gravity is 2.976. It is insoluble in water, but forms with it a paste having some ductility.

It does not combine with oxygen, nor with the simple combustibles, or azote.

It is soluble in the liquid fixed alkalies, like alumina; is insoluble in ammonia, but, like yttria, soluble in carbonate of ammonia.

Mr Davy has rendered it probable, that it is a metallic peroxide. To the metallic basis he proposes to give the name of *glucium*.

Sect. IV. *Of Zirconia.*

Zirconia was discovered by Klaproth in the two minerals called *jargon* or *zircon*, and in the hyacinth. Fuse the pounded mineral with thrice its weight of potash; wash the mass in pure water till the whole of the potash is extracted, then dissolve the residuum as far as possible in muriatic acid; boil the solution, filter and add a quantity of potash. The zirconia precipitates in the state of a fine powder.

Zirconia is a white powder with a harsh feel. It has neither taste nor odour, is infusible before the blowpipe, but when violently heated, acquires the appearance of porcelain. In this state it is hard, and its specific gravity is 4.3. It is insoluble in water, but, when precipitated from a solution and dried slowly, it retains water, and assumes the appearance of gum arabic.

It does not combine with oxygen, simple combustibles, azote, nor metals. But it has an affinity for several metallic oxides.

It is insoluble in liquid alkalies, and infusible with them; but it is soluble in alkaline carbonates.

Mr Davy has made it probable, that it is a metallic peroxide. To the metallic basis he proposes to give the name of *zirconium*.

Sect. V. *Of Silica.*

The minerals called *quartz*, *rock-crystal*, *flint*, &c. consist almost entirely of this earth. It may be obtained in the following manner. Melt in a crucible a mixture of one part quartz powder, and three parts potash; dissolve the mass in muriatic acid, and evaporate to dryness; towards the end of the evaporation, the liquid assumes the form of a jelly; wash the residue in water, and dry it.

Silica, thus obtained, is a fine white powder, with a harsh feel, and without either taste or smell. Its specific gravity is 2.66. It has no effect on vegetable colours, is insoluble in water, and infusible by the heat of our furnaces. It does not form a ductile paste with water, like alumina. It is found native crystallized, most commonly in hexagonal prisms, terminated by six-sided pyramids.

It does not combine with oxygen, the simple combustibles, simple incombustibles, or the metals. It may be fused with several of the metallic oxides.

The fixed alkalies may be fused with it into glass. Ammonia has no action on it. It may be combined with barytes, strontian, lime, and magnesia, by heat. There is a strong affinity between it and alumina.

Mr Davy has rendered it probable, that silica, like the other earths, is a metallic peroxide. To the metallic basis of it he proposes to give the name of *silicium*

Chap. I.

Of Oxides.

Many bodies, as we have seen already, are capable of combining with oxygen. Now, the compounds into which oxygen enters are of two kinds. They either possess the properties of *acids*, or they are destitute of these properties. To the first class the term *acid* has been applied; to the second that of *oxide*. By *oxide*, then, is meant a combination of oxygen and some other substance destitute of the properties belonging to acids.* It is very common to find the same base combine with different doses of oxygen, and form both *acids* and *oxides*. In all these cases, the *smaller* proportion of oxygen constitutes the *oxide*, and the *larger* the *acid*. Hence it follows, that oxides always contain less oxygen than acids with the same base.

The oxides which we have to examine, are combinations of oxygen with the simple combustibles and incombustibles: For the metallic oxides have been already described in the First Book, while treating of the metals. All that is known of the oxides of phosphorus and sulphur has also been stated. We have only to examine in this place, therefore, the oxides of hydrogen, carbon, and azote.

SECT. I. *Of the Oxide of Hydrogen, or Water.*

This well known liquid is found in abundance in every part of the world. When pure, in which state it may be obtained by distillation, it is destitute of colour, taste, and smell.

At the temperature of 40°, a cubic foot of pure water weighs 437102.4946 grains troy, or 999.0914161 ounces avoirdupois. Hence a cubic inch of water at 40° weighs 252.953 grains, and at 60° 252.72 grains. The specific gravity of water is always supposed 1.000, and it is made the measure of the specific gravity of every other body.

When cooled down to 32°, it crystallizes and becomes *ice*. At 212° it boils, and is converted into *steam*, an elastic fluid, invisible like air, and about 1800 times more bulky than water. The boiling point of water is somewhat altered by dissolving salt in it. Some salts raise the boiling point, others lower it a little, while some produce both effects according to the proportion employed.

Water is not altered by heat. It absorbs a little air, and a certain proportion of all gases exposed to it. By long boiling, or by being placed in an exhausted receiver, it is freed from the greatest part of this air.

Water has no action on the simple combustibles while cold; but, at a red heat, charcoal decomposes it. The action of phosphorus is not known. Sulphur, as far as is known, does not decompose it.

Of the metals, iron, zinc, antimony, and tin, decompose it when assisted by heat; silver, gold, copper, and platinum, have no effect on it. The action of the other metals has not been ascertained. The metallic bases of the alkalies and earths decompose it with great rapidity, at the usual temperature of the atmosphere.

Water dissolves the alkalies and alkaline earths. The earths proper are insoluble in it. It dissolves also acids and salts, and is capable of combining with a great variety of bodies. Water unites to bodies two different ways. Some it dissolves, and the compound becomes liquid like water. In this way it dissolves sugar, common salt, and many other bodies. Other bodies combine with it without losing their solidity. The water loses its liquid form, and assumes that of the body with which it unites. In this way it combines with lime, with alumina, with many salts, and with various metallic oxides. When the compound of water with another substance remains liquid, the proportion of water is unlimited; but when the compound formed is solid, the water combines always in a certain determinate proportion. To the first kind of compound, the name of *solution* has been given; to the second, the term *hydrate* has been applied. Thus, *slacked lime* is called *hydrate of lime*; the crystals of barytes and strontian are called *hydrates of barytes and strontian*. Most of the metallic hydrates have lively colours, a strong taste, and are easily soluble in acids; while the oxide which constitutes the base of the hydrate is usually duller in its colour, often tasteless, and always more difficultly soluble in acids. The hydrate of copper is blue, that of nickel and iron green, that of cobalt red, and that of tin white.

All the gases, in their usual state, contain a quantity of water, from which they are best freed by exposure to a very low temperature.

The ancients considered water as an elementary substance. Van Helmont endeavoured to prove, that plants could be nourished by pure water alone, and, of course, that it could be converted into all the substances found in vegetables. Boyle thought that, by long digestion in glass vessels, it could be converted into silica. His experiment was confirmed by Margraff. But Scheele and Lavoisier proved, that the silica was obtained by the decomposition of the glass vessel in which the experiment was made. Mr Cavendish, in 1781, ascertained that water is a compound of oxygen and hydrogen, nearly in the proportion of seven parts of the former, and one of the latter; and this discovery was confirmed by a number of very laborious and rigid experiments.

SECT. II. *Of Carbonic Oxide.*

The substance at present known by the name of *carbonic oxide*, is a gas which was confounded with carbureted hydrogen, till Dr Priestley drew the attention of chemists to it, in a dissertation which he published in defence of the doctrine of phlogiston. It was examined, in consequence, by Mr Cruikshanks, who showed it to be a compound of *oxygen* and *carbon*, and not of *hydrogen* and *carbon*, as Priestley had supposed. Clement and Desormes also analysed it with the same result.

It may be obtained most readily by mixing together equal weights of iron filings and chalk, each as dry as possible, and exposing them to a red heat in an iron retort. A gas comes over in abundance. It consists partly of *carbonic acid*, partly of *carbonic oxide*. The first gas is removed by washing in lime-water. The carbonic oxide remains behind.

Carbonic oxide is invisible, and possesses the mechanical properties of common air. Its specific gravity is 0.956, that of air being 1.000. No animal can breathe it without death. No combustible substance will burn in it.

It burns with a blue flame, giving out but little light, and is wholly converted into carbonic acid gas. When mixed with oxygen gas, and kindled by means of an electric spark, 100 parts of it require 45 parts by bulk of oxygen gas for complete combustion. The result is about 90 parts of carbonic acid gas. From this experiment it has been deduced, that carbonic oxide is composed of

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* This appears to be a correct view of the subject; and if so, it is a sufficient reason for avoiding the indiscriminate application of the terms oxyds and acids, so frequent in chemical writings; as is conspicuous in the combinations of arsenic and oxygen. COXE.

41 carbon.
59 oxygen.

100

The simple combustibles have but little action on this gas. Hydrogen has none, even at a red heat, nor charcoal, nor sulphur. But it dissolves a little phosphorus, and acquires the property of burning with a yellow flame.

The simple incombustibles have no effect on it at any temperature tried. Chlorine gradually destroys it over water, converting it into carbonic acid gas. This mixture cannot be kindled by electricity; whereas a mixture of chlorine and carbureted hydrogen burn directly when an electric spark is passed through them.

Its action on metals and their oxides has been but imperfectly examined. Neither the alkalies nor the earths have any action on it whatever.

SECT. III. *Of the Oxides of Azote.*

Azote and oxygen form two different oxides, both gases, and both discovered by Dr Priestley. The first has been called *nitrous oxide gas*, the second *nitrous gas*, or *nitric oxide gas*.

1. *Nitrous Oxide Gas.*

This gas was discovered by Dr Priestley in 1776, and called by him *dephlogisticated nitrous gas*. The associated Dutch chemists examined it in 1793, and ascertained its composition. But for the best account of it, we are indebted to Mr Davy.

It may be obtained by exposing the salt called *nitrate of ammonia* in a retort to a heat between 340° and 500°. It melts and emits abundance of gas, which may be collected in jars of water.

Thus obtained, it has all the mechanical properties of air. Its specific gravity is 1.603, that of air being 1.000.

It supports combustion better than common air, almost as well as oxygen gas, but for a much shorter time. But combustibles do not burn in it, unless previously in a state of ignition.

It may be breathed for a short time, and produces effects similar to intoxication.

Water absorbs nearly its own bulk of this gas, and acquires a sweetish taste; but its other properties are not perceptibly altered. It may be driven off from the water unaltered by means of heat.

It is not altered by light, nor by a moderate heat. But by a red heat it is decomposed, and converted into *nitric acid* and *common air*.

Oxygen, or common air, has no action on this gas.

Sulphur, if introduced into this gas while burning with a blue flame, is immediately extinguished; but, if it be burning with a violet flame, it continues to burn for some time with great brilliancy with a fine red flame. The products are sulphuric acid and azote.

Phosphorus, when touched with a wire white hot, burns with great brilliancy in this gas. The products are azotic gas, phosphoric acid, and nitric acid.

Charcoal may be kindled in it by means of a burning glass. The products are carbonic acid gas, and azotic gas.

Hydrogen detonates with it by means of electricity. According to Mr Davy, 39 measures of nitrous oxide consume 40 measures of hydrogen, and after the combustion 41 measures of azotic gas remain. From this experiment it has been concluded, that nitrous oxide is composed by weight of

63 azote.
37 oxygen.

100

Sulphureted, phosphureted, and carbureted hydrogen gas likewise burn when mixed with nitrous oxide, and kindled.

Neither azote nor muriatic acid produce any effect upon this gas.

Some of the metals, as iron and zinc, burn or may be oxidized in it.

It has the property of combining with alkalies, and of forming a peculiar species of salt, to which the name of *azotites* may be given. Mr Davy, to whom we are indebted for the discovery of these compounds, did not succeed in combining nitrous oxide with ammonia and the earths, but he has rendered it probable that such compounds are possible.

2. *Nitrous Gas.*

This gas was accidentally obtained by Dr Hales; but its properties were first investigated, and its nature ascertained, by Dr Priestley.

To obtain it, dissolve copper or silver in nitric acid diluted with water, a gas separates, which may be collected in jars over water, and is the gas in question.*

It possesses the mechanical properties of common air. Its specific gravity is 1.094, that of air being 1.000.

It is exceedingly noxious to animals, producing instant suffocation whenever they attempt to breathe it.

Most combustible substances refuse to burn in it. But pyrophorus burns in it with great splendour; and Homberg's phosphorus takes fire in it spontaneously, just as in common air. Dr Henry has ascertained, that ammoniacal gas, when mixed with it, detonates by means of electricity.

When mixed with common air, or oxygen gas, a yellow colour appears; and if the mixture be standing over water, its bulk gradually diminishes very considerably. The yellow colour is owing to the presence of nitrous acid which is formed, and the diminution of bulk to the gradual absorption of that acid by the water. The cause of this remarkable phenomenon is obvious. The nitrous gas combines with the oxygen, and forms nitrous acid. Hence the diminution of bulk depends upon the quantity of oxygen present. There is a good deal of difference in the result obtained by chemists of the amount of the diminution of bulk which ensues. According to Dalton, 21 measures of oxygen gas unite either with 36 measures of nitrous gas, or with 72 measures. According to Gay Lussac, 100 measures of oxygen gas unite either with 200 or with 300 measures of nitrous gas, according to circumstances.

Nitrous gas, by electricity, is converted into nitrous acid and azote.

Water, according to Dr Priestley, absorbs about one-tenth its bulk of this gas; according to Dr Henry, about one-twentieth of its bulk.

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* It is very largely and conveniently obtained likewise in the oxygenation of sugar by the nitric acid. COXE.

It is decomposed by phosphorus and charcoal, and probably also by sulphur at a very high temperature. Hydrogen gas mixed with it burns with a green flame. This mixture, according to Fourcroy, detonates when passed through a red-hot tube.

Neither azote nor muriatic acid produce any effect upon it.

Several of the metals decompose it. When kept for some time in contact with iron, its bulk diminishes, and it is converted into nitrous oxide.

It is absorbed unchanged by a solution of green sulphate or muriate of iron. The liquid acquires a deep brown colour, and, when kept, becomes blue. The gas may be expelled unaltered by heat.

The following bodies convert this gas into nitrous oxide. Alkaline sulphites, hydroguretted sulphurets, muriate of tin, sulphureted hydrogen gas, iron or zinc filings moistened with water.

From the analysis of Mr Davy, it appears to be composed by weight of

57 oxygen.
43 azote.
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100

According to Gay-Lussac, nitrous gas is composed of equal bulks of oxygen and azotic gas united together, and its specific gravity is exactly the mean. Hence no change of bulk takes place when they are combined. This would give us nitrous gas composed by weight of

53 oxygen.
47 azote.
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100

CHAP. V.

Of Acids.

The word *acid*, originally synonymous with *sour*, is at present applied to all bodies possessed of the following properties:

1. When applied to the tongue, they excite that sensation which is called *sour* or *acid*.
2. They change the blue colours of vegetables to red.
3. They unite with water in almost every proportion.
4. They combine with the alkalies, earths, and metallic oxides, and form a class of bodies called *salts*.

Every acid does not possess the whole of these properties. But all of them possess a sufficient number to distinguish them from other bodies. The second and fourth properties are considered as the most important and essential.

It was at one time believed, that there existed only one acid in nature, and that all bodies owed their acidity to the presence of that acid.

This notion was long a favourite one among chemists, and sulphuric and phosphoric acids were pitched upon as the universal acids. But the claims of neither could stand the test of a rigid examination. At last Mr Lavoisier proved, that many substances were capable of combining with *oxygen*, and by that means were converted into acids. Hence oxygen was termed the *acidifying principle*.

All that can be meant by this appellation, is only that many acids contain oxygen as a constituent, and that, when deprived of oxygen, they lose their acid characters. In this sense the appellation is correct enough. But it is not true that oxygen itself possesses acid characters; neither has it been proved that it exists in every acid. Many substances contain oxygen which are entirely destitute of acid properties. Thus water, alkalies, and alkaline earths, contain it. Yet it would be absurd to consider any of these bodies as acids.* As the acids are very numerous, and very heterogeneous in their properties, it will be of some importance to subdivide them into classes. They may be arranged under three heads: 1. Acid products; 2. Acid supporters; 3. Combustible acids.

CLASS I. *Acid Products.*

All the acids belonging to this class possess the following properties:

1. They may be formed by combustion. Of course their base is a simple† combustible.
2. They are incombustible.
3. They resist a violent heat without decomposition. But to this there are some exceptions.
4. They are decomposed by the joint action of a combustible body and caloric.
5. Oxygen is an essential ingredient in all of them.

Some of the combustibles combine with two doses of oxygen, and form two distinct acids. When that happens, the acid containing the smallest dose of oxygen is distinguished by the termination *ous*, while that which contains a maximum of oxygen, is distinguished by the termination *ic*. Thus *sulphurous* and *sulphuric acids*. The first contains the least, and the second the most oxygen.

The following Table exhibits the names of the acid products, their bases, and the proportion of oxygen in each, combined with 100 of the bases as far as it is known at present.

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* To which we may add, that if chlorine constitutes muriatic acid, when united to hydrogen, then we have two acidifying principles. If the simple inflammables (so called) contain hydrogen, as is contended by many excellent chemists, it must be demanded, what becomes of it in the acidification of those bodies?—As all the vegetable and animal acids are admitted to possess hydrogen, without which no acid properties would be evident in them; it almost conclusively follows, that this principle is equally essential to the complete acidification of the acids produced from the (supposed) simple inflammables. COXE.

† It is yet to be proved that any simple combustible exists, except hydrogen, or more properly phlogiston. This appears to be the principle which gives by its presence, combustibility to every other body; and sooner or later, the existence of an uniform principle of inflammability must be admitted in the theories of chemistry. It is highly gratifying to see such an opinion advocated by so excellent a chemist as professor Cooper, of Carlisle. *Vide his Notes to his late edition of Accum's Chemistry*, vol. i. p. 394, & p. 424. *Ibid.*

Names.	Bases.	Proportion of Oxygen to 100 Base.
Sulphuric	Sulphur	150[*]
Sulphurous		100
Phosphoric	Phosphorus	114.7
Phosphorous		58 ?
Carbonic	Carbon	25
Boracic	Boracium	200
Fluoric	Unknown	

Sect. I. *Of Sulphuric Acid.*

Sulphuric acid seems to have been discovered by the alchymists. It was long obtained by distilling the salt called *green vitriol*, or *sulphate of iron*. Hence the names *oil of vitriol* and *vitriolic acid* originally applied to it. It is now procured by burning a mixture of sulphur and nitre in chambers lined with lead, the bottom of which is covered with water. The acid formed is dissolved by the water, and is concentrated by distillation in glass retorts.[†]

Sulphuric acid is liquid, somewhat of an oily consistency, transparent and colourless as water, without any smell, and of a very strong acid taste. It destroys the texture of animal and vegetable substances. Its specific gravity, when as strong as possible, is about 1.85. It changes all vegetable blues to red, except indigo.[‡] When of the specific gravity 1.842, it boils at 546°. When exposed to cold, it crystallizes or congeals. The temperature necessary depends upon the strength. When of the specific gravity 1.780, it freezes at 45°. When stronger or weaker, it requires a much greater degree of cold.

It has a strong attraction for water, and when exposed to the atmosphere, imbibes nearly seven times its weight of that liquid. When the two liquids are mixed together, a considerable heat is evolved. Thus four parts of acid and one of water raise the thermometer to about 300°. The density of this mixture is always considerably greater than the mean. From the experiments of Kirwan, it appears that the strongest sulphuric acid of commerce contains almost 1-5th of water, the remaining 4-5ths are pure acid.[§]

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[*] With respect to the great diversity of opinion as to the proportions of oxygen and sulphur in this acid, see the detail in the preceding part of this work, as a note, under the head of sulphur. That exposition is sufficient to evince the, as yet, unsettled state of chemistry; and will afford proof how slight a distance we have advanced towards constructing any perfect theory. Coxe.

[†] A new theory of the formation of sulphuric acid has been published by Desormes and Clements, to which they appear to have been led, by considering, that the proportion of nitre used in the process does not contain a sufficient quantity of oxygen to convert the sulphureous into sulphuric acid. As we cannot refer to the volume of *Annales de Chemie* which contains it, we present our readers with Sir H. Davy's modification of the same, which is more satisfactory.

"The sulphur, by burning, forms sulphureous acid gas, and the acid in the nitre is decomposed, giving off nitrous gas; this coming in contact with the oxygen of the atmosphere, produces nitrous acid gas, which has no action upon sulphureous acid, to convert it to sulphuric acid, unless water be present, and if this substance be only in a certain proportion, the water, the nitrous acid gas, and the sulphureous acid gas combine, and form a white crystalline solid. By the large quantity of water usually employed, this compound is instantly decomposed, oil of vitriol formed, and nitrous gas given off, which in the air again becomes nitrous acid gas, and the process continues according to the same principle of combination and decomposition, till the water at the bottom of the chamber is become strongly acid."

Should the above reasoning be confirmed, we think it probable, that sulphuric acid will hereafter be formed without the addition of nitre; as the nitrous gas may be furnished by many processes of the laboratory, particularly during the dissolution of mercury and silver, for preparing red precipitate and lunar caustic; also, during the dissolution of copper in sulphuric acid, with the addition of a little nitric acid to furnish oxygen; as in the preparation of sulphate of copper.

We deem it proper to add, that Parks, in a note to the 3d edition of his *Chemical Catechism*, 1805, p. 535, on the authority of an ingenious youth, grand-son to Dr Priestley, says, that the above theory was tried on a large scale at Birmingham, and failed. Not one drop of acid was formed, although a current of nitrous gas was continually thrown into the chamber where sulphur was burning for two days and nights. We are totally at a loss to conceive what could have occasioned the failure; as the result of no experiment in chemical science is more uniform than the production of sulphuric acid, on the mixture of sulphurous acid gas and nitrous gas, provided water be present. If Mr Parks' young friend is to be literally understood, *that not one drop of* any *acid* was formed, he was undoubtedly misinformed, as the nitrous gas and the oxygen of the air of the chamber would combine, and form nitric acid, whilst from the quantity of nitrous gas thrown in during two days and nights, the water of the chamber must at least have become diluted nitric acid.

In our judgment, the sulphur should be burned in a furnace without (not within) the chamber, and possess a moderate draught, to carry the sulphurous acid gas into the chamber. Hembel, jun.

[‡] There is not a single property ascribed to the class of bodies called acids, which is, either, not deficient in some of the class, or is to be found in other bodies not allied to them! What then, it may be asked, is the property that oxygen, as the acidifying principle, affords exclusively to them? Coxe.

[§] Can any of the acids be procured in a perfectly dry state? It is very doubtful. If they can, is there one which in such a state of complete siccity, would evince the pro-

The following Table, drawn up by Mr Dalton from his own experiments, exhibits the strength and the boiling point of sulphuric acid of various densities.

Sp. Gr. of acid.	Realacid per cent. by weight.	Boiling point.
1.850	81	620°
1.849	80	605
1.848	79	590
1.847	78	575
1.845	77	560
1.842	76	545
1.838	75	530
1.833	74	515
1.827	73	501
1.819	72	487
1.810	71	473
1.801	70	460
1.791	69	447
1.780	68	435

Sp. Gr. of acid.	Realacid per cent. by weight.	Boiling point.
1.769	67	422°
1.757	66	410
1.744	65	400
1.730	64	391
1.715	63	382
1.699	62	374
1.684	61	367
1.670	60	360
1.650	58.6	350
1.520	50	290
1.408	40	260
1.30+	30	240
1.200	20	224
1.10—	10	218

From the most accurate experiments hitherto made, sulphuric acid appears to be composed of

60 oxygen.
40 sulphur.

100

This acid is not altered by exposure to light nor heat. Oxygen gas does not act upon it nor combine with it.

The simple combustibles have but little effect upon it at the ordinary temperature of the atmosphere, but when assisted by heat, they all decompose it. When hydrogen gas and the acid are passed through a red-hot tube, water is formed, and sulphur deposited. Charcoal absorbs oxygen from it, and readily converts it into sulphurous acid, or into sulphur, if the heat be long continued. Phosphorus and boracium produce the same effect. Sulphur, when boiled with it, readily converts it into sulphurous acid.

Azote has no action on it; but it readily absorbs muriatic acid, and forms a smoking compound, which acts powerfully upon some metals.

Sulphuric acid, when concentrated, has little action on the metals. When diluted, it dissolves iron and zinc with rapidity, water is decomposed, and hydrogen gas emitted.* When heated, it oxidizes several of the metals, and sulphurous acid is exhaled. On gold and platinum it produces no effect whatever.

It unites readily with the alkalies, earths, and metallic oxides; and forms with them a class of bodies called *sulphates*.

It absorbs a good deal of nitrous gas, and acquires, in consequence, a purplish colour.†

This acid is of great importance, both in chemistry, and the arts.

SECT. II. *Of Sulphurous Acid.*

The existence of this acid was pointed out by Sta but Priestley was the first who procured it in a separate state. It may be obtained by distilling in a retort a mixture of two parts sulphuric acid, and one part of mercury. An effervescence takes place, and a gas comes over, which may be received in jars over mercury.

It is colourless, and possesses the mechanical properties of common air. It has a strong and suffocating odour, precisely the same as that emitted by burning sulphur. Its specific gravity is 2.265, that of air being 1.000. It reddens vegetable blues, and gradually destroys the colour altogether.

When strongly heated, sulphur is deposited, and sulphuric acid formed. When exposed to the temperature of —18°, it is condensed into a liquid.

Water absorbs 33 times its bulk of this gas. The liquid has the smell of the gas, an acid and sulphureous taste, and the specific gravity 1.0513. It may be frozen without parting with the gas. But when heated, the gas is expelled. When this liquid is left to itself, it gradually absorbs oxygen, and the acid is converted into the sulphuric.

Sulphur and phosphorus seem to have no action on this acid; but hydrogen and charcoal decompose it when assisted by heat, and sulphur is evolved. Neither azote nor muriatic acid produce any effect upon it.

It oxidizes and dissolves iron, zinc, and manganese.

It combines with the salifiable bases, and forms salts called *sulphites*.

Sulphuric acid absorbs it, and forms a singular compound called *glacial sulphuric acid*, which readily becomes solid, and smokes when exposed to the air.

Its constituents are 50 sulphur,
50 oxygen.

100

SECT. III. *Of Phosphoric Acid.*

This acid was first mentioned by Boyle, but its properties were investigated many years after. It may be obtained by burning phosphorus, or by dissolving phosphorus in nitric acid, and evaporating the liquid to dryness.‡

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perties of acids? This may be also doubted. And hence, it might be contended, that water is the acidifying principle of all the class, perhaps with equal force, as that oxygen is the exclusive acidifying principle. COXE.

* The common opinion that the sulphuric acid is not decomposed, although its presence is absolutely essential in the process, and merely, because it is said that it can subsequently combine with as much alkali as previously to the process, is adduced as an example of what has been termed disposing affinity. As it can be satisfactorily explained on the common doctrines of the anti-phlogistic school, without requiring such a sacrifice of reason, as the present explanation demands; it is desirable that the advocates of the opinion would give it their particular attention, so that the absurdities it involves, as Dr Henry justly observes, should be no longer upheld. COXE.

† I have passed this gas through it till it would absorb no more; but could never perceive this purplish colour. It may nevertheless be as stated. *Ibid.*

‡ If the above process is repeated in the desultory manner in which it is related, it may be attended with

In this state it is solid, colourless, and transparent, not unlike glass. It reddens vegetable blues, has no smell, but has a very acid taste. When exposed to the air, it attracts moisture, and gradually runs into an oily-like fluid. Its specific gravity when in the state of glass is 2.8516; when in the liquid state, 1.417.

It is very soluble in water, and is said to be capable of crystallizing, but it is difficult to obtain it in that state.

Oxygen has no effect upon it. None of the simple combustibles are known to be capable of decomposing it, except charcoal.* When strongly heated with this substance, phosphorus is disengaged. The simple incombustibles have no effect on it.

It is capable of oxidizing and dissolving some of the metals; but its action on these bodies is by no means strong.

It combines with the salifiable bases, and forms a class of salts called *phosphates*.

According to the experiments of Rose, it is composed of
46.5 phosphorus,
53.5 oxygen.

100.0

SECT. IV. *Of Phosphorous Acid.*

This acid was known earlier than the preceding. For a long time they were confounded. Lavoisier was, perhaps, the first who accurately distinguished them. It may be obtained by exposing phosphorus to the open air: it gradually absorbs oxygen, and runs into a liquid, which is the acid in question.

It is a viscid colourless liquid, having a very acid taste, and emitting the smell of garlic, especially when heated. It combines with water in any proportion. When evaporated to dryness and heated, it gives out phosphureted hydrogen gas, which burns when it comes in contact with the air. This continues for a long time, and at last the acid is converted into the phosphoric. If nitric acid be poured upon it, this change takes place much more easily and speedily.

The action of the simple combustibles, the incombustibles, and the metals on this acid, is similar to their action on phosphoric acid.

It combines with the different salifiable bases, and forms a class of salts called *phosphites*.

Sulphuric acid, by the assistance of heat, converts it into phosphoric acid.

It has been ascertained that this acid contains less oxygen than the phosphoric, but the actual proportion has not been determined.

SECT. V. *Of Carbonic Acid.*

This acid was discovered by Dr Black. Its properties were afterwards investigated by Mr Cavendish and Dr Priestley, and its composition ascertained by Mr Lavoisier. It was at first called *fixed air*. Mr Lavoisier, after ascertaining its base, gave it the name which it now bears. Every chemist almost of eminence, during the last 50 years, has added something to our knowledge of the properties of this remarkable substance.

It may be obtained by burning charcoal, or more easily by pouring muriatic acid on chalk in a glass retort, and receiving the gas which is extricated in glass jars over water. This gas is the acid in question.

It is invisible, and possesses the mechanical properties of air. No combustible will burn in it.† It is unfit for respiration. It affects the nostrils with a kind of pungent sensation, but when diluted with air it has no smell whatever. Its specific gravity is 1.500, that of air being 1.000. It reddens very delicate vegetable blues.

Atmospheric air contains about $\frac{1}{1000}$ of its bulk of this gas.

It is not altered by passing it through a red hot tube; but when electric sparks are passed through it for a long time, its bulk increases, and a portion of carbonic oxide is evolved.

Water absorbs it when placed in contact with it. The rapidity of the absorption is much increased by agitation. Water absorbs its own bulk of this gas at the temperature of 41°. The water acquires a sour taste, a sparkling appearance, and the property of reddening vegetable blues. When heated or frozen, the gas is extricated. It makes its escape also if the liquid be left exposed to the open air.

Carbonic acid is not acted upon by oxygen, nor, as far as is known, is it altered by any of the simple combustibles, incombustibles, or metals. But several of these bodies, as charcoal, phosphorus and different metals, have the property of decomposing it at a red heat, when it is in combination with lime, barytes, or strontian. In these cases a quantity of carbonic oxide is usually evolved.

It combines with the salifiable bases, and forms a class of salts called *carbonates*.

From the most exact experiments hitherto made, we may consider this acid as composed very nearly of
28 carbon.
72 oxygen.

100

SECT. VI. *Of Boracic Acid.*

This acid is obtained from the salt called *borax*, brought to Europe from the East, where it is found chiefly at the bottom of some lakes in Thibet and China. It was first extracted from borax by Homberg,‡ and its

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the most eminent danger to the operator. The nitric acid should only be gently warmed, and the phosphorus added in *very small pieces* at a time; on each addition, a violent effervescence ensues, and a quantity of red vapours are disengaged; if the acid is too hot, or the pieces of phosphorus too large, the latter take fire and burst the vessel to pieces, dispersing the acid and phosphorus to a considerable distance. HEMBEL, jun.

[*] The action of combustibles is in many cases very extraordinary, and appears to be inexplicable on common opinions. Thus phosphoric acid is decomposed by charcoal; yet charcoal, although the only substance capable of so doing, cannot precipitate copper in a metallic state from its solutions; which phosphorus readily accomplishes. COXE.

[†] Potassium burns in it, according to the experiments of Mr Davy. COXE.

[‡] And called from him, the sedative salt of Homberg. *Ibid.*

nature was ascertained by Baron. To obtain it, dissolve borax in hot water, and add sulphuric acid till the liquid assumes a sensibly acid taste. As the liquid cools, it deposites white crystalline scales, which are *boracic acid*.

Thus obtained, it has the form of thin hexagonal scales of a silvery whiteness. Its taste is sourish and bitterish. It has no smell. It reddens vegetable blues. Its specific gravity, while in scales, is 1.479, when melted 1.803.

It is not altered by light nor heat. In a red heat it melts into a transparent colourless glass, which becomes somewhat opake when exposed to the air, but does not attract moisture.

Boiling water does not dissolve more than 0.02 of this acid, and cold water still less.

Neither oxygen, the simple combustibles, incombustibles, or metals, produce any effect upon this acid. But when heated with potassium it is decomposed, and its base *boracium* separated.

From the experiments of Davy, we may conclude that boracic acid is composed of about 33 boracium.
67 oxygen.

100

It is soluble in alcohol, and alcohol containing it burns with a green coloured flame.[*] It dissolves also in some of the oils.

It is hardly capable of oxidizing any of the metals except iron and zinc.

It combines with the salifiable bases, and forms a class of salts called *borates*.

Sect. VII. *Of Fluoric Acid.*

This acid was dicovered by Scheele. He obtained it from a pretty common and beautiful mineral called *fluor spar*, and in this country often Derbyshire spar. This mineral is a compound of fluoric acid and lime. Dr Priestley first obtained the acid in a separate state.

To procure this acid, pour sulphuric acid on the pounded spar, and apply heat. A gas comes over, which must be received over mercury. It is the acid in question.

This gas possesses the mechanical properties of air. It does not support combustion,[†] nor can animals breathe it. It smokes when mixed with the atmosphere, and has a smell similar to that of muriatic acid.

It is not altered by exposure to heat or light.

Water absorbs it rapidly. If glass vessels have been employed to procure it, a jelly is deposited as soon as it comes in contact with the water. This jelly consists of silica, which the gas has dissolved from the glass, and which it held in solution. No method has been yet discovered of obtaining fluoric acid gas free from foreign matter.[‡] If leaden vessels be used, the gas does not assume the elastic form, at least we could not procure it by means of these vessels.[§] When fluor spar and vitreous boracic acid are heated together, a gas is obtained, which is a combination of the two acids, to which Thenard and Gay Lussac, who discovered this compound gas, have given the name of *fluoboracic* acid gas.

Neither oxygen, the simple combustibles, incombustibles, or metals, as far as is known, produce any effect upon this gas. It does not act powerfully upon the metals.

The fluoboracic acid is absorbed by water, and forms a very powerful acid liquid, nearly as heavy as sulphuric acid, and capable of resisting as strong a heat before it is volatilized.[‖]

One of the most curious properties of fluoric acid is the ease with which it corrodes glass, when that substance is exposed to its fumes. In consequence of this property, it has been employed to etch upon glass.

It combines with the different bases, and forms a class of salts called *fluates*.

All attempts to decompose this acid have failed, in consequence chiefly of the impossibility of making experiments on it in a state of purity.

Class II. *Acid Supporters.*

The acid supporters are distinguished by the following properties:

1. They cannot be produced by combustion. Hence their base is either a simple incombustible or a metal.
2. They support combustion.[¶] Hence they acidify the combustible bases, and oxidize the metals.
3. They are decomposed at a high temperature, their oxygen making its escape in the state of gas.

The only acid supporters known at present, are those which have the simple incombustibles and arsenic for their bases. From analogy, we refer the whole of the metallic acids to this head.

The following Table exhibits a view of all the acid supporters, of their bases, and of the proportion of their constituents, as far as that has been ascertained.

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[*] Here is another instance of a combustible body affording a peculiar coloured light in inflammation, through the agency of a non-combustible; and consequently, another proof, against the opinion of the light in combustion, being derived from combustibles. Coxe.

[†] Potassium burns in it, according to Davy. *Ibid.*

[‡] The gas above spoken of, is not pure fluoric acid, but what has been called silicated fluoric acid gas—from holding silex in solution. The real fluoric acid is a fluid, of a nature more active and powerful in many respects than even sulphuric acid. Thenard and Gay Lussac, have given the best account of this very extraordinary substance. Mr Davy has likewise treated of it, in his *Elements*, p. 265. He appears disposed to consider the silicated fluoric gas, and fluoboric gas, as "compounds of a principle unknown in the separate state, but analogous to chlorine, with silicum and boron." If this is correct, then we may hereafter have to admit a variety of acidifying principles, in addition to oxygen, the only one so regarded by the antiphlogistic theory. Coxe.

[§] In our experiments, we never used other than tinned iron vessels, made in the shape of a frustrum of a cone, having a neck with an aperture sufficient to admit a cork: we always found them answer perfectly. Hembel, jun.

[‖] What is remarkable is, that this compound acid has no action upon silex as the fluoric acid has; hence it is procured, without injury to the retort, by distilling fluor spar, boracic acid and sulphuric acid together. Coxe.

[¶] So far as this is a property of the class, both carbonic and fluoric acid gases, are entitled to a place in this division, since potassium burns in them. *Ibid.*

Names.	Bases.	Proportion of Oxygen to 100 base.
Nitric	Azote	236
Nitrous		
Arsenic	Arsenic	53
Tungstic	Tungsten	25
Molybdic	Molybdenum	50
Chromic	Chromium	200
Columbic	Columbium	

Oxygen is an essential constituent of all these acids, as well as of those belonging to the first class.

Sect. I. *Of Nitric Acid.*

This acid seems to have been first obtained in a separate state by Raymond Lully, one of the most celebrated of the alchymists. It was called at first *water of nitre*, *aqua fortis*, *spirit of nitre.*

It may be obtained, by distilling a mixture of three parts nitre and one of sulphuric acid in a glass retort.

The acid thus obtained has a yellow colour; but, if kept for a short time in a boiling heat, it becomes colourless. It has a peculiar smell, it smokes when exposed to the atmosphere. Its taste is extremely acid, and it is one of the most corrosive substances known, tinging the skin instantly of an indelible yellow, and very soon destroying its texture entirely. It converts vegetable blues to red. Its specific gravity when strongest never exceeds 1.583. It contains mixed with it a considerable portion of water, from which it cannot be freed. When strongest, this water amounts to about one-fifth of the whole.

The following Table, by Mr Dalton, exhibits the strength and boiling point of this acid when of various densities.

Specific gravity of acid.	Real acid per cent. by weight.	Boiling point.
1.62	82.7	
1.54	72.5	175°
1.50	68	210
1.45	58.4	240
1.42	54.4	248
1.40	51.2	247
1.35	44.3	242
1.30	37.4	236
1.26	32.3	232
1.22	28.5	229
1.20	25.4	226
1.18	23	223
1.17	21	221
1.16	19.3	220
1.15	17.8	219
1.14	16.6	219

When of the specific gravity 1.42 it boils at 248°, and may be distilled over without alteration. When cooled sufficiently it congeals, and the freezing point varies exceedingly according to the strength of the acid. There is a certain strength at which it congeals most easily, and, if it be either stronger or weaker, the freezing point is considerably lower.

Oxygen has no effect upon this acid; but all the simple combustibles decompose it. When poured upon charcoal, phosphorus, or sulphur, at a high temperature, it sets them on fire. When diluted, it effervesces with these bodies, and acidifies them. Hydrogen gas does not act upon it at the common temperature of the atmosphere, but when passed with it through a red hot tube, it detonates, water is formed, and azotic gas disengaged. Boracium is readily converted by it into boracic acid. When poured upon the volatile oils, and even upon several of the fixed oils, it sets them on fire. If it be previously mixed with a little sulphuric acid, it sets almost all the oils on fire.

Azote has no action on this acid, but muriatic acid forms with it the compound called *aqua regia*, or *nitro-muriatic acid.*

It is capable of oxidizing all the metals, except gold, platinum, and titanium. With most of the oxides it combines, though some, as the peroxides of tin and antimony, are insoluble in it. It even sets fire to some of the metals, when poured upon them in fusion.

It absorbs nitrous gas in great abundance, and becomes first yellow, then orange, then olive, and at last green, according to the proportion of gas present. Acid thus contaminated with nitrous gas was formerly called *dephlogisticated nitric acid*, and *nitrous acid ;* on the supposition that it was nitric acid deprived of a portion of its oxygen. When fully saturated with nitrous gas, it assumes a gaseous state, and is known by the name of gaseous vapour.

Nitric acid combines with the different salifiable bases, and forms a class of salts called nitrates.

It has been ascertained, that this acid is a compound of oxygen and azote in the following proportions.

29.77	azote.
70.23	oxygen.
100.00	

Sect. II. *Of Nitrous Acid.*

When *nitre*, which is a compound of nitric acid and potash, is exposed to a red heat, it yields a considerable portion of oxygen gas. If the process be conducted with the proper precautions, and stopped in time, the nitre still retains the properties of a neutral salt. But the acid which it contains is obviously in a different state, since it has lost a considerable part of its oxygen. To this new state the term *nitrous acid* is applied.

In this state it was discovered by Scheele, but all attempts to obtain the acid by itself have failed. It is decomposed apparently whenever it is separated from the potash; for fumes of nitrous gas immediately make their appearance.

Sect. III. *Of Arsenic Acid.*

This acid was discovered by Scheele. It may be formed in the following manner: Mix in a retort one part of muriatic acid, four parts of white oxide of arsenic, and 12 parts of nitric acid of the specific gravity 1.25. Boil the mixture till the oxide disappear, and nitrous fumes cease to be disengaged; then evaporate to dryness, and expose the mass to a low red heat. The matter thus obtained is solid *arsenic acid.*

It is a white solid mass nearly tasteless, of the specific gravity 3.391. It is very fixed. It melts at a red heat, and is converted into glass.

It dissolves slowly in cold, but rapidly in hot water, and by cautious evaporation may be obtained in crystals.* The taste of the solution is acid, caustic, and metallic.

Oxygen has no effect on it. The simple combustibles decompose it when assisted by heat, and sometimes take fire, in consequence of its action on them, a proof that this acid is a supporter of combustion.

The simple incombustibles have no action on it. It oxidizes several of the metals, especially when assisted by heat.

It combines with the salifiable bases, and forms a class of salts called *arseniates.*

It has no action on any of the acids already described.

From the analysis of Proust, it appears that this acid is composed of

65 arsenic.
35 oxygen.
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100

Sect. IV. *Tungstic Acid.*

The substance originally called tungstic acid, was discovered by Scheele. It was not pure, being contaminated by the acid employed in separating it.

The real tungstic acid is a yellow powder, first described by the Eluyarts. It is tasteless, insoluble in water, and has no effect on vegetable blues. It is rather an oxide than an acid. But it combines with the salifiable bases, and forms a class of salts called *tungstates.*

Sect. V. *Of Molybdic Acid.*

This acid was discovered by Scheele. It has been lately examined by Bucholz.

It may be obtained by digesting nitric acid on molybdena, till the whole is converted into a white mass. Edulcorate this mass with water, the residue is molybdic acid.

It is a white powder, of the specific gravity 3.460. In close vessels it melts and crystallizes when heated; but in open vessels it sublimes, and may be collected in the form of brilliant yellow scales.

It is soluble in 960 parts of water. The solution is pale yellow. It is tasteless, but reddens vegetable blues.

Molybdic acid is not affected by oxygen gas; but it is decomposed by sulphur and charcoal, and several of the metals.

It combines with the salifiable bases, and forms a class of salts called *molybdates.*

It dissolves in sulphuric acid. The solution is colourless when hot, but becomes blue when cold. It dissolves also in muriatic acid, but not in nitric acid.

According to the analysis of Bucholz, it is composed of

67 molybdenum
33 oxygen.
———
100

Sect. VI. *Of Chromic Acid.*

This acid was discovered by Vauquelin. It may be obtained from the *red lead ore* of Siberia, by boiling the ore with carbonate of soda, decanting off the fluid solution, and saturating it with sulphuric acid. A red powder falls, which is *chromic acid.*

It has a red or orange yellow colour, an acrid and metallic taste; is soluble in water, and crystallizes in elongated prisms of a ruby colour.

When heated it gives out oxygen gas, and is converted into green oxide of chromium.

When mixed with filings of tin and muriatic acid, it becomes at first yellowish brown, and afterwards assumes a beautiful green colour. When treated with acids, and various other combustibles, a green colour is also evolved.

Sect. VII. *Of Columbic Acid.*

This acid was discovered by Hatchet in an ore from America, of a black colour, which he found in the British Museum. It was obtained by fusing the ore with potash, dissolving the potash in water, and adding nitric acid to the solution. The columbic acid precipitated in flakes.

It is a powder of a white colour, and not very heavy. It is tasteless, insoluble in water, but gives a red colour to vegetable blues.

Sulphuric acid dissolves it, and forms a colourless solution, from which the columbic acid is precipitated by water. It is soluble also in muriatic acid, but not in nitric acid.

It combines with the salifiable bases, and forms a class of salts called *columbates.*

Class III. *Combustible Acids.*

The acids belonging to this class may be distinguished by the following properties.

1. If they be combined with potash, and distilled, they are decomposed, charcoal is usually evolved, and a considerable quantity of heavy inflammable air extricated.

2. All of them contain at least two simple combustibles as a base, namely *carbon* and *hydrogen.* Some of them also contain *azote.* Oxygen usually enters into their composition, though not perhaps always.†

3. They do not seem capable of combining with different doses of oxygen. Whenever the proportion of oxygen changes, that of the other constituents varies also.

4. They are decomposed by the action of the more powerful acid supporters, and either converted into other combustible acids, or into oxide and acid products.

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* By oxygenating the white oxyd (improperly so called) by boiling nitric acid on it; after long standing, brilliant crystals deposite at the bottom of the bottle, of arsenic acid; at least it has so occurred to me in one instance. Coxe.

† If not always, how has it any right to the specific title of the acidifying principle? It is also an objection to that opinion, that oxygen should form with bases of the same class, both acids and alkalies, substances possessed of properties entirely different. Coxe.

They may be divided into four orders. Those belonging to the first crystallize, and may be volatilized without decomposition. Those belonging to the second likewise crystallize, but they cannot be volatilized without decomposition. Those belonging to the third order are not crystallizable, though they may be exhibited in the state of a dry mass. Under the fourth order are placed three acids, which, from the singularity of their properties, ought to be considered apart.

The following Table exhibits the names and component parts of each of these acids, as far as is known at present.

ORDER I. *Crystallizable, volatilizable.*

Names.	Constituents.
1. Acetic.	Carbon, hydrogen, oxygen.
2. Benzoic.	
3. Sebacic.	
4. Succinic.	
5. Moroxylic.	
6. Camphoric.	
7. Oxalic?	

ORDER II. *Crystallizable, not volatilizable.*

Names.	Constituents.
1. Mellitic.	Carbon, hydrogen, oxygen.
2. Tartaric.	
3. Citric.	
4. Kinic.	
5. Saclactic.	
6. Uric.	Carbon, hydrogen, azote, oxygen.

ORDER III. *Not Crystallizable.*

1. Malic.	Carbon, hydrogen, oxygen.
2. Suberic.	
3. Formic.	

ORDER IV. *Colorific.*

1. Prussic.	Carbon, hydrogen, azote.
2. Gallic.	Carbon, hydrogen, oxygen.
3. Tannin.	

SECT. I. *Of Acetic Acid.*

This has been the longest known of all the acids. It is obtained by causing *wine* or *beer* to undergo a new fermentation. They become sour, and are known by the name of *vinegar*. When the vinegar is distilled, a transparent colourless liquid is obtained, called *distilled vinegar*, or sometimes *acetous acid*. When this substance is combined with oxide of copper, and the dry mass distilled, a liquid is obtained, which contains the acid in a much more concentrated state. It was formerly called *radical vinegar*, and *acetic acid*, by way of eminence.

It is now known that the acid principle in all these three liquids is precisely the same, and that they differ merely in the concentration of that acid, or in consequence of containing small quantities of some foreign ingredient. Hence, the term *acetic acid* is now applied to the acid in all cases.

Acetic acid is a liquid, transparent and colourless like water. It has a peculiar and well known aromatic smell, when in the state of vinegar or distilled vinegar. In radical vinegar this smell is not so agreeable, being mixed with a kind of empyreumatic odour. When sufficiently concentrated, it may be obtained in crystals; but the process is difficult, and requires particular precautions to ensure success.

The specific gravity of distilled vinegar varies from 1.007 to 1.0095: that of radical vinegar is 1.080. But the strength of the acid is not always proportional to its specific gravity, owing to the presence of foreign bodies, from which it is very difficult to free it. It is very volatile, unites with water in any proportion, and reddens vegetable blues.

Neither oxygen, the simple combustibles, or incombustibles, have any action on this acid. It oxidizes some metals; but its action on these bodies is not violent. It combines with metallic oxides, and forms with every one a soluble salt. Indeed, all the salts that contain acetic acid are soluble in water. In this respect it agrees with nitric acid.

It combines with salifiable bases, and forms a class of salts called *acetates*.

Sulphuric and nitric acids seem capable of decomposing it, but the action of the other acids is not remarkable. It dissolves and combines with many vegetable bodies, and is, in consequence, useful in vegetable analysis.

It is composed of oxygen, hydrogen, and carbon, according to the experiments of Thenard and Gay Lussac, in the following proportions:

Oxygen,	44.147
Hydrogen,	5.629
Carbon,	50.224
	100

SECT. II. *Of Benzoic Acid.*

This acid is obtained, by sublimation, from a resinous substance called benzoin.

It is a fine light white matter in small needles. It is not brittle, but has a kind of ductility. Its taste is acrid, hot, and somewhat bitter. Its odour is weak but aromatic. Its specific gravity is 0.667. It reddens the most delicate vegetable blues.

It is easily volatilized by heat. It burns when kindled, and leaves no residuum. It is not altered by exposure to the air. Cold water dissolves no sensible quantity of it, but it dissolves readily in hot water.

It is not acted upon by oxygen gas, or by any of the simple combustibles or incombustibles; nor does it seem capable of oxidizing any of the metals.

It combines with the salifiable bases, and forms a class of salts called *benzoates*.

Several of the strong acids dissolve it; but it is precipitated again unaltered by the infusion of water. Alcohol dissolves it copiously.

SECT. III. *Of Sebacic Acid.*

This acid was mentioned many years ago, but its nature and properties remained unknown till it was lately examined by Thenard. Berzelius has lately added considerably to our knowledge of it. It may be prepared by the following process.

Distil hog's lard; wash the product with hot water, separate this water and drop into it acetate of lead. A flaky precipitate appears which is to be washed and dried, mixed with sulphuric acid and heated. A melted substance, like fat, swims on the surface. This substance is sebacic acid.

Sebacic acid is white; it has no smell; its taste is a pleasant sour, leaving in the mouth a very slight impression of bitterness. It reddens vegetable blues. When heated, it melts like tallow, and, on cooling, concretes into a crystallized mass. It may be volatilized, but requires a higher temperature than benzoic acid. Berzelius has shown that this acid, in most of its properties, coincides with benzoic acid; and that the two acids, if not absolutely the same, at least approach very closely to each other.

Sect. IV. *Of Succinic Acid.*

This acid is obtained when amber is exposed to heat. It sublimes in small needles, coloured by an oil, from which it may be freed by digestion in nitric acid and subsequent crystallization. Trommsdorf affirms, that when dry saclactic acid is distilled, it yields abundance of succinic acid.

This acid is white, crystallizes in triangular prisms, has an acid taste, and reddens vegetable blues. When heated, it melts and then sublimes.

It is but little soluble in cold, but very soluble in hot water. Alcohol acts nearly upon it as water. It dissolves in sulphuric, nitric, and muriatic acids, without undergoing decomposition.

It combines with the salifiable bases, and forms a class of salts called *succinates*.

Sect. V. *Of Moroxylic Acid.*

This acid was discovered by Klaproth in a saline exudation incrusting the bark of the white mulberry tree. This salt was a compound of the acid in question and lime.

The acid was separated by dissolving the salt in water, and precipitating the acid by means of acetate of lead. The precipitate was mixed with diluted sulphuric acid and digested. Sulphate of lead was formed, and moroxylic acid disengaged.

It crystallized in needles, which had the taste of succinic acid, were not altered by exposure to the air, and dissolved readily in water and in alcohol. When heated it sublimes, and thus may be obtained quite pure.

Sect. VI. *Of Camphoric Acid.*

This acid was discovered by Kozegarten, but first accurately described by Bouillon La Grange.

It is obtained by distilling a solution of camphor in nitric acid, repeatedly adding nitric acid till it amounts to 24 times the weight of the camphor. Crystals gradually make their appearance, which consist of *camphoric acid*.

This acid is snow-white. Its crystals are parallelopipeds which effloresce in the air. Its taste is acid and bitter, it has the smell of saffron, and reddens vegetable blues.

It dissolves in about 100 parts of cold water, but is more soluble in hot water. It dissolves in alcohol. The salts which it forms are called *camphorates*.

Sect. VII. *Of Oxalic Acid.*

This acid was discovered by Scheele, and first described by Bergman. It is obtained by heating a solution of sugar in nitric acid.*

It crystallizes in small four-sided prisms, terminated by dihedral summits. These crystals are composed of 77 parts acid, and 23 water. When exposed to heat, it sublimes, but at the same time is partly decomposed.

These crystals have a very acid taste, and redden vegetable blues. They dissolve in their own weight of boiling water, and in twice their weight of cold water. They dissolve, also, readily in alcohol.

When exposed to dry air, they effloresce; but in moist air, they are not altered. Neither oxygen, nor the simple combustibles or incombustibles act on this acid. It oxidizes some of the metals; but most of them are not affected by it.

It combines with the salifiable bases, and forms a class of salts called *oxalates*.

Muriatic and acetic acids dissolve it; sulphuric acid decomposes it, by the assistance of heat. Nitric acid converts it into water and carbonic acid.

When combined with a base and distilled, it is decomposed, and converted into *water*, *carbonic acid*, *carbonic oxide*, *carbureted hydrogen*, and *charcoal*. It is composed, according to the experiments of Dr Thomson, of

oxygen,	64
carbon,	32
hydrogen,	4
	100

Thenard and Gay Lussac make its constituents as follows:

oxygen,	70.689
carbon,	26.566
hydrogen,	2.745
	100

Sect. VIII. *Of Mellitic Acid.*

This acid was discovered by Klaproth, in the mineral called *mellite* or *honeystone*, which he found composed of alumina and the acid in question.

It is obtained by boiling the mineral powder in 72 times its weight of water, filtering the liquid, and evaporating sufficiently. The mellitic acid crystallizes.

The crystals are needles, having a brownish colour, and a sweetish sour taste. It is but moderately soluble in water. Nitric acid does not seem to decompose it. It reddens vegetable blues. The salts which it forms are called *mellates*.

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* It is remarkable, as observed by Aikins in their *Chemical and Mineralogical Dictionary*, vol. ii. p. 191. that no other agent but the nitrous acid has yet been found capable of producing the oxalic acid. Even the oxymuriatic acid, one of the most powerful of the oxygenating agents, fails to convert sugar into oxalic acid, but in its stead generates some acetous acid and probably carbonic acid and water. Hembel, jun.

SECT. IX. *Of Tartaric Acid.*

This acid exists in the salt called *tartar*, from which it was first obtained in a separate state by Scheele. The process is this:

Dissolve tartar in water, and add chalk in powder as long as an effervescence continues. A white powder precipitates. Pour on this precipitate a quantity of sulphuric acid equal in weight to the chalk employed, previously diluted with water, and digest for a day or two. Then filter and evaporate the liquid. The tartaric acid is obtained in crystals.*

These crystals are white, transparent, and hard. They are very irregular four-sided prisms, composed of 84.5 real acid, and 15.5 water.

It is not altered by exposure to the air. At 212°, it melts and becomes as liquid as water. At 250°, it boils without losing its transparency or acquiring colour. When cooled, it concretes into a hard mass, but the nature of the acid is changed. It has now acquired the property of deliquescing when exposed to the air. When distilled, this acid yields an acid liquid formerly called pyrotartarous acid, but now known to be the acetic disguised by means of an empyreumatic oil. When combined with a base and distilled, tartaric acid is decomposed, and converted into *water*, *carbonic acid*, *heavy inflammable air*, and *charcoal*.

It dissolves readily in water, and when the solution is diluted, the acid undergoes spontaneous decomposition.

None of the simple substances produce any striking effect upon this acid. It combines with the salifiable bases, and forms a class of salts called *tartrates*.

According to Thenard and Gay Lussac, it is composed of

Oxygen,	69.321
Carbon,	24.050
Hydrogen,	6.629
	100

SECT. X. *Of Citric Acid.*

This acid exists in the juice of oranges and lemons, and was first obtained pure by Scheele. His process was this:

Saturate lemon-juice with chalk. A precipitate falls. Wash this precipitate, and pour on it as much sulphuric acid as will saturate the chalk employed, previously diluted with six times its weight of water. Digest, filter, and evaporate the liquid. The citric acid crystallizes.†

This acid crystallizes in rhomboidal prisms. The crystals are not altered by exposure to the air. The taste is acid, and vegetable blues are reddened by it. It dissolves in less than its weight of water.

It is not acted on by the simple substances. It oxidizes a few of the metals. It combines with the salifiable bases, and forms a class of salts called *citrates*.

Sulphuric acid decomposes it. Nitric acid converts it into oxalic acid, or into acetic acid, if used in excess.

Its constituents, according to Thenard and Gay Lussac, are as follows:

Oxygen,	59.859
Carbon,	33.811
Hydrogen,	6.330
	100

SECT. XI. *Of Kinic Acid.*

This acid was discovered by Vauquelin, in a salt first obtained from *Jesuits bark*, by Deschamps. This salt is a compound of kinic acid and lime.

Vauquelin dissolved the salt in water, and precipitated the lime by means of oxalic acid. The liquid was evaporated to the consistence of a syrup, and then set aside. No crystals formed in it at first, but on being touched, it wholly crystallized in diverging plates.

Its colour is somewhat brown, its taste very acid and bitter. It was not altered by exposure to the air. It is very soluble in water. It does not precipitate silver nor lead from their solutions. When heated, it is decomposed, and charcoal remains behind.

SECT. XII. *Of Saclactic Acid.*

This acid was discovered by Scheele, who formed it by digesting sugar of milk in nitric acid. Fourcroy and Vauquelin ascertained, afterwards, that it is formed when gum is heated with nitric acid, and the solution allowed to cool. A white powder precipitates, which is the acid in question.

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* The many impurities which common tartar contains makes the following process, from *Henry's Chemistry*, 6th edition, vol. ii. p. 151. far preferable to the one given in the text:

Let 100 parts of finely powdered cream of tartar be intimately mixed with about 30 parts of pulverized chalk. This is best done by grinding them in a mortar, and passing the mixture through a sieve. Let the mixture be thrown, by spoonful, into eight or ten times its weight of boiling water; waiting for the cessation of the violent effervescence, which is produced by each addition, before any more is thrown in. This method I find preferable to the entire solution of the cream of tartar in the first instance, which requires a very large quantity of water. If it should appear, from the effect of the liquor on litmus paper, that the chalk has not been added in sufficient quantity, more may be gradually used, until the colour of the litmus is no longer reddened.

By this operation, a quantity of insoluble tartrate of lime will be formed, which is to be allowed to subside, and washed, three or four times, with cold water. To the tartrate of lime, diffused through a sufficient quantity of water, concentrated sulphuric acid may be added, equal in weight to the chalk which has been employed. The mixture may be allowed to stand for 24 hours, during which it should be frequently agitated. Assay a little of the clear liquor, by pouring into it some solution of acetate of lead. A copious precipitate will be formed, which may either consist of tartrate of lead, or of a mixture of tartrate with sulphate of lead. To determine this, add diluted nitric acid, which dissolves the tartrate but not the sulphate. A small portion of the latter is desirable, because the tartrate of lime cannot be wholly decomposed without an excess of sulphuric acid; but a large excess of that acid is injurious, from its reacting on the tartaric acid, when heat is applied in the subsequent part of the process. The deficiency of sulphuric acid should be supplied by adding more; or a great redundance of it removed by the addition of a little chalk. The evaporation of the solution may now be carried on, and the crystals purified by a second solution and evaporation. HEMBEL, jun.

† In *Annales de Chemie*, vol. vi. it is stated by Vauquelin, that citric acid may be obtained, by passing oxymuriatic acid through a solution of gum arabic in water for a considerable time. HEMBEL, jun.

Saclactic acid, thus obtained, is in the form of a white gritty powder, with a slight acid taste. It is only slightly soluble in boiling water. The solution has an acid taste, and reddens vegetable blues.

The compounds which this acid forms with the salifiable bases, are called *saccolates*.*

The constituents, according to Thenard and Gay Lussac, are as follows:

Oxygen,	62.69
Carbon,	33.69
Hydrogen,	3.62
	100

Sect. XIII. *Of Uric Acid.*

This acid was discovered by Scheele in urinary calculi, and first called *lithic acid.* But this term was afterwards laid aside, and *uric acid* substituted; because this acid constitutes one of the ingredients of urine. For the best account of the properties of this acid, we are indebted to Dr Henry.

It is obtained by dissolving the calculi, composed chiefly of it, in alkaline ley, and precipitating by means of muriatic or acetic acids. The white powder which falls, when well edulcorated, is pure uric acid.

It is a white powder, without taste or smell. It reddens vegetable blues, and requires more than 1700 parts of cold water to dissolve it.

It dissolves readily in fixed alkaline solutions, but not in alkaline carbonates. It dissolves in nitric acid; and when the solution is evaporated nearly to dryness, it assumes a fine pink colour, which becomes much deeper when water is added, so as to have a near resemblance to carmine. The watery solution of this matter loses its red colour in a few hours, and it cannot afterwards be restored.

Oxymuriatic acid readily converts the uric into the oxalic acid.

When distilled, carbonate of ammonia is obtained, and a saline sublimate, which Dr Henry has shown to be a compound of ammonia with a peculiar acid.

Sect. XIV. *Of Malic Acid.*

This acid was discovered by Scheele. It exists in apples, and in a variety of vegetable substances. It is formed also by the action of nitric acid on sugar.

Scheele obtained it by saturating the juice of apples with potash, precipitating by acetite of lead, digesting the precipitate in a sufficient quantity of sulphuric acid to separate the lead, and then filtrating. The liquid contained pure malic acid.

When malic acid is obtained by the action of nitric acid on sugar, it is colourless; but it very easily acquires a brown colour by the action of heat, or even by keeping it in a liquid state. When evaporated, it may be obtained in a solid state; but it is not capable of crystallizing.† Its taste is very acid, and it dissolves readily in water. I is said to undergo spontaneous decomposition; but we have kept it more than two years in a liquid state without observing any such change.‡ It bears a strong resemblance to the citric acid, but it does not crystallize; forms a more soluble salt with lime; and precipitates mercury, lead, and silver, from nitric acid, which citric acid does not.

The compounds which it forms with the salifiable bases, are called *malates.*

Sect. XV. *Of Suberic Acid.*

This acid was obtained by Brugnatelli by digesting common cork in nitric acid. Its properties were afterwards more investigated by Bouillon La Grange.

It does not crystallize, but may be obtained in powder or in pellicles. Its taste is acrid and slightly bitter; it reddens vegetable blues, attracts moisture when exposed to the air, but is not very soluble in water. It may be sublimed without decomposition. The other acids dissolve it incompletely. The salts which it forms are called *suberates.*

Sect. XVI. *Of Formic Acid.*

This acid exists in the *formica rufa*, or *red ant.* It was noticed in a paper by Mr Ray in 1671, in consequence of the observations of Halse and Fisher. But its properties were first investigated by Margraff. Fourcroy and Vauquelin endeavoured to prove that it was a mixture of

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* This is not the proper denomination, if we follow the spirit of the new nomenclature; it should be saclactats. This is an uncouth term, as is indeed the name of the acid itself. Since the usual method of obtaining it, is by the means of gum, it might very properly be called *gummic* acid, and its compounds, gummats. The name is easier, and the base of its composition is hereby discriminated. Coxe.

† It is, however, said by Aikins, vol. ii. p. 54, *Chemical and Mineralogical Dictionary*, to crystallize at about 7°, but the crystals dissolve as the temperature rises.
Hembel, jun.

‡ We are also possessed of some more than three years old; it retains its property of precipitating silver, lead, and mercury, from nitric acid, but does not precipitate alumine; from whence we infer, that it has undergone decomposition. We subjoin from *Annales de Chemie*, vol. xxviii. p. 193, a method of preparing it by R. Chenevix, Esq. which as an extemporaneous preparation will be found very convenient to the practical analyst.

"On adding oxymuriatic acid to powdered sugar, the acid is decomposed at the moment of contact, and loses its property of destroying blue vegetable colours: malic acid is at the same time formed.

"In the liquor there remains simple muriatic acid, which cannot be expelled by heat, without destroying the malic acid; but, as the malat and muriate of magnesia are equally soluble in alcohol, and there would be no muriate of alumina formed, unless the muriatic acid found a base of magnesia, we may avail ourselves of this method to obtain malic acid. As the calcareous salts formed by the acid thus obtained are very soluble, we may doubt, whether any citric acid is formed, as has hitherto been believed; at most, a little acetic acid is produced." *Ibid.*

acetic and *malic acids;* but the experiments of Suersen have shewn that this opinion is not correct.

This acid may be obtained by infusing the ants in water, distilling off the water as long as it comes over without any burnt smell, saturating the water with potash, evaporating to dryness, mixing the residue with as much diluted sulphuric acid as is sufficient to saturate the potash employed, distilling this mixture to dryness, rectifying the liquid that comes over by a second distillation with a moderate heat. The liquid now contains only pure formic acid.

This liquid is colourless like water. It has a peculiar smell; it reddens vegetable blues, and has an acid taste. Its specific gravity varies from 1.102 to 1.113, whereas the most concentrated acetic acid is only 1.080. Notwithstanding this superior weight, it is not capable of neutralizing so much of the salifiable bases as acetic acid. Lowitz attempted, in vain, to procure this acid in crystals, though he succeeded easily with acetic acid. The compounds which it forms with the different bases are called *formates*. There is a striking analogy between them and the *acetates*.

Chap. VI.

Of Colorific Acids.

Under this name we include three substances, which possess such peculiar properties that they ought to be considered separately from the combustible acids. These are *prussic acid*, *gallic acid*, and *tannin*. The two first have always been considered as acids. The last, though not acid, is so intimately connected with the gallic, that they cannot well be separated. These substances possess the following characters.

1. They unite with alkaline bodies, but do not seem capable of neutralizing them.

2. They act with great energy upon metallic solutions, usually entering into combination with the oxide, and precipitating it in the state of an insoluble powder.

3. They have a tendency to enter into triple compounds with a variety of bodies, especially with metallic oxides and alkalies.

Sect. I. *Of Prussic Acid.*

This important substance was accidentally discovered by a chemist of Berlin in 1710. This chemist, Diesbach by name, found out the method of preparing *Prussian blue*. The nature of this pigment was examined by Brown. But it was Macquer who first ascertained its nature in a satisfactory manner. In consequence of his experiments, Prussian blue was considered as a compound of oxide of iron, with a peculiar acid. But no one was able to obtain this acid in a separate state, or to ascertain its properties, till Scheele, in two admirable dissertations, published in 1782 and 1783, pointed out a method of procuring it, and gave a detailed account of its nature.

He procured the Prussic acid in the following manner: He boiled in a matrass a mixture of 10 parts Prussian blue, 5 parts red oxide of mercury, and 30 parts of water, and filtered the solution. The liquid was poured upon 2½ parts of clean iron filings, and at the same time 1 part of sulphuric acid was added, and the mixture shaken. The iron disappeared, and a quantity of running mercury was precipitated in its place. Distil off one-fourth of this liquid by a moderate heat, what comes over consists of water holding prussic acid in solution.

Prussic acid, thus obtained, is a colourless liquid like water. It has a strong odour, resembling that of the flowers of the peach or of bitter almonds. Its taste is sweetish, acrid, and hot, and it is apt to excite cough. It does not alter the colour of vegetable blues. When swallowed, it proves a very virulent poison.*

In this state it is combined with water; but Gay Lussac obtained it pure by the following process: He put into a tubulated retort a quantity of prussiate of potash, and poured over it weakly fuming muriatic acid. The retort was luted to a flask containing a mixture of chalk and muriate of lime in powder. This flask communicated with a second containing muriate of lime, and this with a third empty. The flasks were surrounded with a mixture of two parts snow, and one part salt. A gentle heat being applied to the retort, the prussic acid passed over, and swam above the muriate of lime. By gently heating the first flask, the acid is made to pass into the second flask, and by this means is rectified.

Prussic acid, thus obtained, is a limpid and colourless liquid. It is extremely volatile and pungent; boiling at the temperature of 80°, and at the temperature of 50° it supports a column of mercury rather more than ten inches high. At 68° it quintuples the bulk of any gas with which it is mixed. It freezes at 2°. In consequence of this extreme volatility and easy congelation, a curious phenomenon takes place. If a drop of it be let fall upon a sheet of paper, it immediately freezes, in consequence of rapid evaporation. The specific gravity of this liquid is 0.70583 at the temperature of 44.5°. It reddens vegetable blues.

It is capable, when dry, of withstanding a red heat without decomposition; but when water is present, it very readily undergoes change.

It combines with the salifiable bases, and forms a class of bodies called *prussiates*. But they have very little permanency, being decomposed by all other acids, and even by exposure to the atmosphere.

It is also capable of forming triple compounds, in which it is combined with two bases at once, one of them an alkali or earth, the other a metallic oxide. These compounds are much more permanent, and are therefore usually employed by chemists. The one in most frequent use is the *triple prussiate of potash*, a yellow coloured salt crystallizing in cubes, and composed of prussic acid, potash, and oxide of iron.

Scheele succeeded in forming prussic acid, by causing a current of ammoniacal gas to pass through red hot charcoal; and the experiment has been since repeated successfully by others. Hence it is obvious, that this acid is composed of the constituents of ammonia and charcoal united together, or of hydrogen, azote, and carbon. This has been further confirmed by Berthollet. Chlorine has the property of altering the nature of prussic acid, and renders it capable of throwing down iron from solutions, *green* instead of blue. To the acid thus altered, Berthollet gave the name of *oxyprussic acid*. When heat is applied to it, the whole is converted into carbonate of ammonia.

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* It is the peculiar principle which gives its poisonous property to the distilled water of the Lauro-Cerasus. It also exists in the almond and peach kernels, &c. Coxe.

Prussian blue may be formed, by calcining a mixture of potash and dried blood in a covered crucible, in a heat gradually raised to redness. The mass is dissolved in water, and poured into a solution of sulphate of iron. A green coloured precipitate falls, which becomes prussian blue when digested in muriatic acid. The triple prussiate of potash was formerly called phlogisticated alkali. It is still useful in detecting different metals in solutions, by the colour of the precipitate which it occasions, especially iron, which it throws down of a deep blue.

SECT. II. *Of Gallic Acid.*

This acid forms one of the constituents of the substance called *nutgalls*, a concretion formed on the oak in consequence of the puncture of insects. Nutgalls come to this country chiefly from the Levant. They vary a good deal in their appearance. Scheele first separated gallic acid from nutgalls. An infusion of nutgalls left to itself for some time, becomes mouldy on the surface, and lets fall small crystals. These crystals being picked out, dissolved in water, and obtained again by evaporation, constitute *gallic acid*.

The acid obtained by this process is never quite pure. If the infusion of nutgalls be evaporated to dryness, and the powdered residue be digested in pure alcohol, the alcohol, when cautiously distilled to one-eighth, leaves a residue behind it nearly colourless, which is soluble in water, and yields by evaporation gallic acid in needles, much lighter coloured and purer than that obtained by the first described process.*

Gallic acid is white, usually with a shade of brown or yellow. It is crystallized in needles or transparent plates. Its taste is acid, and somewhat astringent; and when heated, it exhales a peculiar and rather unpleasant aromatic odour. It is soluble in 1½ parts of boiling, and in 12 parts of cold water. When the solution is heated, the acid is decomposed. When long kept, it becomes darker coloured, and the acid is likewise altered in its properties.

When heated, it sublimes, but its properties are somewhat altered. When distilled, it yields, like other vegetable acids, carbonic acid gas, and heavy inflammable air. Water is also formed, and a portion of the acid escapes, slightly modified in its nature.

It is not altered by exposure to the air. Neither oxygen gas, the simple combustibles, or incombustibles, seem to produce any effect upon it. The action of the metals is unknown.

The compounds of this acid, with the salifiable bases, are called *gallates*. They have scarcely been examined. When gallic acid is dropt into lime, barytes, or strontian water, it strikes a bluish red colour, and occasions a flaky precipitate. It occasions a precipitate likewise when poured into the solutions of yttria, glucina, or zirconia in acids. Upon metallic solutions it acts with considerable energy, changing their colour, and occasioning precipitates in many of them. Thus, with iron it strikes a dark blue, or almost black colour.† When

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* To obtain this acid, the best method is to evaporate to dryness an infusion of galls in water; to this add alcohol, which takes up the gallic acid, and may then be filtered from the insoluble residue. To prevent the loss of the alcohol, the solution thus obtained may be distilled nearly to dryness from a retort; and the evaporation may then be continued in the open air at a very gentle heat, or even by atmospheric exposure. The solid matter thus left has a crystalline appearance, somewhat resembling Muscovado sugar. If this mass be mixed with clean dry sand, in a glass subliming vessel, surmounted by a paper cap or cone, and exposed to a sand heat; after a portion of moisture is expelled, the gallic acid sublimes in most delicate, brilliant, white needleform crystals towards the top of the glass, and in the paper cone, much in the same way as is seen in subliming benzoic acid. When perfectly pure, it has not the slightest tinge of yellow or brown; and in this state it is largely dissolved by alcohol, which speedily assumes a brownish colour. Neither the acid nor its alcoholic solution precipitate the solutions of iron black or blue. A greenish, soon changing to a brownish colour, is acquired by the solution of iron, which in a few hours permits a small precipitate to take place.—From the experiments I have made with this substance, I do not think it has any effect whatever in producing the black colour of ink, or in dyeing. The subject is sufficiently interesting to be reconsidered in its full extent.

Light appears to have a slight action upon this acid. A portion made about a year ago, which was put into a perfectly clean dry glass-stopper bottle, and left in that state exposed to the light, gradually acquired a darkish tint, upon the surfaces in contact with the glass, although the internal part continued perfectly white. COXE.

† Some years past, we repeated all the processes detailed in books for procuring the gallic pure; by none of them could we succeed so well as by the following: One ounce of finely powdered galls were introduced into a stoppered bottle; ten ounces of alcohol, of specific gravity 0.796, were poured on it, and the whole suffered to digest in the temperature of the atmosphere (during summer) for one week, the bottle being frequently shaken during the interval; the alcohol was then separated by filtering, and immediately distilled to dryness in a water bath. The distilled alcohol was returned on the galls, and suffered to remain another week, when it was distilled and returned on the remaining galls again, which, after the expiration of another week, was also distilled to dryness.

The powders obtained from the three distillations were collected on the centre of a porcelain saucer; a head of a glass alembic was placed over the powder, and the empty space between the saucer and alembic was filled with well washed fine dry sand, as a substitute for luting. The saucer was placed on a sand bath, and a thermometer sunk about one inch below the surface of the sand. When the thermometer indicated 218°, the head of the alembic was obscured by a vapour; shortly after, minute crystals were seen to form on the inner surface; when they ceased to increase, the head was removed, and another substituted. The bath was now raised to 224°, some crystals were formed, at the same time a pungent odour was diffused through the room, which produced such convulsive coughing and violent sneezing, as induced me to terminate the experiment. The crystals obtained in the first experiment were white as snow; of a silky or rather argentine lustre; their shape was not easily determined, as they decussated each other so variously, that the eye could not trace their ramifications: however, they resembled needles more than any shape to which we could compare them.

As the gutter of the alembic head did not permit the it precipitates metallic oxides, it seems to bring them nearer to the metallic state, and sometimes reduces them altogether. Thus gold is precipitated by it in the metallic state.

Sect. III. *Of Tannin.*

Nutgalls, besides gallic acid, contain several constituents; one of the most curious and important of these is tannin, which is to occupy our attention in this Section.

Tannin was first pointed out in vegetables by Deyeux, though some of its properties had been noticed long before by Lewis. Seguin first pointed out its great importance in tanning, and hence the name was given it, by which it is at present known. Proust endeavoured to obtain it in a separate state. Mr Davy added to our knowledge of its properties. But it is to Mr Hatchett that we are indebted for the most important set of new facts. He pointed out a method of making it artificially from almost all animal and vegetable substances. As Mr Hatchett's tannin differs in several respects from the tannin of nutgalls and other astringent substances, it will be proper to divide this section into two parts.

1. *Natural Tannin.*

No unexceptionable method of obtaining tannin from nutgalls, in a state of complete purity, has yet been discovered. The best method is this:

Make an infusion of nutgalls in water, evaporate the infusion to dryness, pulverize the residuum, and digest the powder in repeated portions of pure alcohol till that liquid ceases to dissolve any thing. The residue is tannin, tolerably pure. It may be dissolved in water, and precipitated by acetate of lead. The edulcorated precipitate being mixed with water, and a current of sulphureted hydrogen passed through it, the lead combines with sulphur and remains insoluble; while the tannin, thus set at liberty, dissolves in the water, and may be obtained by evaporating the liquid.

Tannin, thus obtained, is a brittle substance of a brown colour, with an astringent taste like that of nutgalls. It dissolves readily in water, and the solution, according to Trommsdorf, is not liable to become mouldy. Pure alcohol does not dissolve it; but it is soluble in alcohol diluted with a little water, as for example in alcohol of 0.818 of specific gravity, which contains $\frac{1}{10}$th of its weight of water.

It seems capable of combining with oxygen, but its properties are, by that means, completely altered; being, according to Proust, a species of *extractive.*

The action of the simple combustibles on tannin is unknown. The action of the metals is probably small, but it combines with most of the metallic oxides, and forms compounds which, for the most part, are insoluble in water. Thus it strikes a deep blue or black with solutions of iron, and if the solutions be diluted, the compound of tannin and the oxide of iron precipitates.

When a solution of *glue*, or *gelatine*, as chemists term it, is poured into an aqueous solution, a precipitate immediately falls. This precipitate consists of tannin and gelatine combined together. It is insoluble in water, and composed, according to Davy, of 54 gelatine and 46 tannin. This property renders gelatine a very delicate test of tannin, which it detects when it exists, even in small proportion, in vegetable liquids.

The alkalies combine with tannin, and prevent it from precipitating gelatine, till they are saturated with an acid.

The earths combine with tannin, and form with it compounds nearly insoluble. Hence they precipitate it from the infusion of nutgalls.

Most of the acids combine with tannin, and form soluble compounds with it. Arsenic, muriatic, and sulphuric acids precipitate it from water. The sulphuric acid gradually decomposes it. Nitric acid also decomposes it, and a substance is formed having the properties of malic acid.

Such are the properties of the tannin of nutgalls, as

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crystals to be easily extracted, half an ounce measure of alcohol was poured in; by that means they were dissolved and introduced into a stoppered bottle: the crystals obtained in the second experiment being coloured, they were set aside for a future sublimation. Into a dilute solution of sulphate of iron, some of the alcohol solution of gallic acid was added; no discoloration of the liquid appeared; a single drop of common alcohol of galls produced an immediate black colour. Into another dilute solution of sulphate of iron, three drops of oxymuriatic acid were added, with a view to further oxidize the iron; two drops of the alcohol solution of galls produced no discoloration; but one drop of common alcohol of galls, produced an immediate blackness. Considering, that one ounce of powdered galls were digested for three weeks with thirty ounces of the strongest alcohol which can be obtained, it appeared reasonable to conclude, that not a vestige of gallic acid could be retained by it; and consequently, if the black colour in dyeing, &c. is produced by the combination of the gallic acid only with the sulphate of iron, then our powdered galls should produce no colour with solutions of sulphate of iron. With a view to determine that fact, the following experiment was made. Into a dilute solution of sulphate of iron, as much of the above powdered galls as could be raised by the point of a quill tooth-pick was added; immediately on the powder becoming wetted, a bluish black colour began to appear, which quickly spread, from the point of contact, in all the radii of the surrounding sphere, and the solution, on being stirred with a glass rod, became uniformly black.

From the above, and a number of other experiments on the same subject, we are led to conclude, that gallic acid has no effect on solutions of iron, to produce a black colour: but that the *solution of sulphate of iron combines with the colouring matter of the galls, and precipitates it black.*—A phenomenon analogous to the precipitating of the colouring matter of cochineal scarlet, by nitro-muriate of tin.

For the satisfaction of some of our friends, who witnessed some of the above experiments four years past, and who expressed their apprehensions that our gallic acid was deteriorated by the process of its formation, we subjoin the following extracts from the second edition of *Elements de l'Art de la Teinture, par C. L. et A. B. Berthollet*, vol. i. p. 115.—Patterns of silk, wool, and cotton, were impregnated with gallic acid; then passed into a solution of iron: none of them became coloured. Similar patterns, impregnated with a solution of galls, were easily coloured.—Ib. p. 124. Gallic acid cannot of itself serve to dye a black, but *it may* contribute to the effect, by means of the tannin, &c.—They add, tannin may serve, without the aid of gallic acid, to dye a black, &c. &c. Hembel, jun.

far as they have been ascertained. The difficulty of obtaining it in a state of purity renders some of them ambiguous, and has induced chemists to employ the infusion of nutgalls in their experiments rather than tannin.

This infusion is employed in considerable quantity by dyers, and it forms the principal ingredient of common *writing ink*. This liquor consists of a solution of sulphate of iron in the infusion of nutgalls. No other salt of iron tried answers so well as the sulphate. The deepest black is formed when equal weights of nutgalls and of sulphate of iron are employed. But it is not permanent unless the nutgalls amount to about thrice the weight of the sulphate. The best ink, according to Dr Lewis, who made many experiments on the subject, may be made by means of the following formula.

Logwood,	1 ounce.
Nutgalls, in powder,	3
Green vitriol,	1
Water,	1 or 2 quarts.

Boil the logwood and the nutgalls in water, adding new liquid in proportion to the evaporation, then strain through a cloth and dissolve the green vitriol, adding at the same time one ounce of gum arabic and a little sugar. Some recommend the addition of a little cloves to prevent the ink from moulding.*

Tannin exists in many other substances besides nutgalls. The barks of many trees, the substances called catechu and kino, logwood, brazil wood, fustick, and many other vegetable bodies, yield it in abundance. From the experiments of Proust, it appears that it varies in its qualities in these bodies, or that there are different species of tannin, varying from each other in several respects, especially in the colour which they strike with iron. Some precipitate that metal black, some green, and some flesh-red.

2. *Artificial Tannin.*

The important discovery, that a substance capable of tanning leather like the tannin of nutgalls, may be formed artificially, was made by Mr Hatchett, in the course of a set of experiments on the slow carbonization of vegetable bodies, and detailed by him in various papers read to the Royal Society in 1805.

To form it, we have only to digest diluted nitric acid on charcoal, till the whole, or nearly the whole, is dissolved, and evaporate the solution to dryness; a brown coloured matter remains, which is *artificial tannin*. 100 grains of charcoal, by this process, were converted into 120 grains of artificial tannin. A part of this increase is moisture, and it is very difficult to get rid of the whole of the nitric acid, a portion of which adheres to the tannin with great obstinacy.

Tannin, thus prepared, is a substance of a brown colour, it has considerable lustre, and breaks with a vitreous fracture. Its taste is very bitter and highly astringent. It has no smell. It dissolves readily in cold water, forming a brown coloured solution. Alcohol, of the specific gravity 0.800, also dissolves it.

The solution is precipitated by gelatine very readily. The precipitate is brown, and composed, according to Hatchett, of 36 tannin and 64 gelatine.

Sulphuric and muriatic acids form a precipitate when poured into solutions of artificial tannin. Nitric acid does not decompose it nor alter its properties. This forms a marked distinction between natural and artificial tannin.

The alkalies unite with it, and prevent it from precipitating gelatine till they are saturated. The alkaline earths, and most of the metallic oxides, form insoluble compounds with it. Hence it precipitates most of these bodies from their solutions.

When distilled, artificial tannin yields water, a little nitric acid, and a yellow coloured liquid; on raising the fire, ammoniacal gas is disengaged with great rapidity; this is followed by carbonic acid gas, and a gas possessing the properties of azote. A bulky charcoal remains behind. From these results it is obvious that this substance consists of oxygen, azote, hydrogen, and carbon. The last constituent, no doubt, predominates.

Mr Hatchett has shewn that every charcoal, both from animal and vegetable substances, provided it be in the state of charcoal, yields artificial tannin when digested with nitric acid. He has pointed out two other methods of procuring a substance possessed of similar properties. The first is by dissolving indigo and the resins, or gum resins, in nitric acid, and digesting them for a considerable time in that liquid. When the solution is evaporated to dryness, a yellow coloured matter remains, which possesses the properties of artificial tannin.† The second method is by dissolving camphor and the resins in sulphuric acid, digesting till the solution becomes black, and then precipitating by pouring it into cold water. If the black powder which falls be digested in alcohol, a brown matter is taken up, which possesses many of the properties of artificial tannin.

Such are the properties of the colorific acids. They act with most energy on metallic solutions, forming precipitates which vary in their colour according to the metal. It is this property which renders them of so much importance in a chemical point of view. The following Table exhibits a view of the colours which these bodies strike with the different metals, as far as is known.

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* I have tried a great variety of recipes for the formation of ink, and find none (not excepting that of Dr Lewis above mentioned) equal to that of Mr Ribancourt. *Chem. An.* vol. ii.—I have now before me a paper with writing upon it of this ink, of July 19, 1805, which has been constantly exposed to every chance of injury from the air, the sun, dust, smoke, and moisture; the paper itself has become of a dingy dirty brown, from these sources, but the ink has augmented in blackness, and evinces not the smallest decomposition. His recipe is as follows:—Galls 8 oz. logwood 4 oz. These are to be boiled for an hour in 12 lbs. of water, or until one-half is evaporated; it is then percolated through a hair sieve, and to the liquid are added, sulphat of iron 4 oz. gum arabic 3 oz. sulphat of copper 1 oz. sugar candy 1 oz. The solution is well stirred, and suffered to stand for 24 hours; it is then poured off from the sediment, and is to be preserved in well stopped glass or stone jars. Coxe.

† A substance something similar to artificial tannin I once formed, by digesting to dryness, repeatedly, small quantities of nitric acid upon camphor; a dark coloured substance resulted, which had lost the smell of camphor. I intended to have made some experiments upon it, but it got mislaid, and I have never since pursued the subject. Coxe.

Metals.	Prussiate of Potash.	Gallic Acid	Infusion of Nut-galls.	Artificial Tannin.
Gold	Yellowish white	Reduced	Reduced	Reduced.
Platinum	0	0	0	
Silver	White	Yellowish brown	Yellowish brown	Yellow
Mercury	White	Orange yellow	Orange yellow	Yellow
Palladium	Olive			
Rhodium	0			
Iridium	0 Becomes colourless		0 Becomes colourless	
Osmium			Blue	
Copper	Greenish yellow	Brown	0 Becomes olive	Olive
Iron	Blue	Black	Black	Brown
Nickel	Green	White	Grey	
Tin	White		Brown	Blackish grey
Lead	White	White	White	Brown
Zinc	White	0	0	0
Bismuth	White	Orange	Orange	
Antimony	0	White	White	Yellow
Tellurium	0		Yellow	
Arsenic	White	0	0	Yellow ?
Cobalt	Brown yellow	0	Yellow white	
Manganese	Yellow white	0		
Chromium	Green		Brown	
Molybdenum				
Uranium	Brown red		Chocolate	
Tungsten	Brown		Straw yellow	
Titanium	Yellowish brown		Blood red	
Columbium	Olive		Orange	
Cerium	White	0	0	

CHAP. VII.

Of the Compounds of Chlorine.

WE shall in this Chapter give an account of the compounds which chlorine forms with all the other simple substances, as far as the subject has been investigated. For all the experiments hitherto made on the subject, we are indebted to Mr Davy, and his brother, Mr John Davy.

1. Chlorine has the property of combining with oxygen. The compound is a gas of a yellow colour, which may be obtained by pouring diluted muriatic acid on the salt called hyperoxymuriate of potash, and applying a moderate heat. The gas may be received over mercury. It was discovered, and its properties investigated, by Mr Davy, who has given it the name of *euchloric* gas.* Its colour is greenish yellow, and very intense. Water absorbs about ten times its bulk of it. Its specific gravity is 2.61. It is composed of two parts in volume of chloric gas, and one of oxygen gas. When heated, it is decomposed, and light and heat are produced.

2. Chlorine combines very readily with hydrogen, and forms the very important compound called *muriatic acid*. When the gases, each as dry as possible, are mixed together in equal bulks, and the mixture exposed to the light of the sun, inflammation takes place, the two gases disappear, and a quantity of muriatic acid gas is formed, nearly equal to them in bulk. Now, as the specific gravity of muriatic acid gas is almost exactly the mean of the specific gravity of hydrogen and chloric gas, it is inferred that it is a compound of equal bulks of these gases. Therefore muriatic acid is composed by weight of

97.24 chlorine,
2.76 hydrogen.
———
100.00

or of one part of hydrogen and about 35 of chlorine. But if we suppose, with Mr Davy, that the proportion of hydrogen exceeds that of chloric gas in bulk, we may consider muriatic acid as composed of one part hydrogen and 33 of chlorine.

Muriatic acid may be obtained by putting some common salt in a small glass retort, pouring over it sulphuric acid, and receiving the product over mercury.

Muriatic acid gas is invisible, and possesses the mechanical properties of common air. Its specific gravity is 1.278, that of air being 1.000. Its smell is pungent and peculiar, and when mixed with air it forms a visible smoke, owing to its great avidity for moisture.

It does not support combustion, nor can it be breathed by animals. When a lighted taper is plunged into it, it goes out with a green coloured flame.†

Water, when brought into contact with this gas, absorbs it with great rapidity, and the whole disappears. Water absorbs 515 times its bulk of this gas, and six cubic inches of water by this absorption are converted into nine. The affinity between this gas and water are very great.

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* If Mr Davy's opinion of this substance is finally admitted, I apprehend a term adapted to shew the *constitution* of this compound gas would be preferable to that above mentioned; such a term may perhaps be found in that of *oxy-chloric* gas. COXE.

† Whatever be the base of muriatic acid, this circumstance of its affording a green colour to a lighted taper, renders it probable that the base of fluoric acid is the same, since it produces a nearly similar effect, and its smell is also the same as that evinced by muriatic acid. *Ibid.*

Water saturated with this gas is known by the name of *liquid muriatic acid*. It has been long known, and is very much employed by chemists. When pure, it is transparent and colourless: but it very often has a greenish yellow colour, owing to the presence of iron or of some other impurity. It has the smell of muriatic acid gas, and smokes when exposed to the air. Its specific gravity is never greater than 1.203, and seldom exceeds 1.196; and when strongest, never contains more than one-fourth of its weight of acid: the rest is water.

The following Table gives us the strength and boiling point of muriatic acid of various densities. It is from the experiments of Kirwan and Dalton.

Specific gravity of acid.	Real acid per cent. by weight.	Boiling point.
1.199	25.6	
1.181	23.4	
1.166	21.6	170°
1.154	20.0	190
1.144	18.7	212
1.136	17.5	217
1.127	16.4	222
1.121	15.5	228
1.094	12.1	232
1.075	9.91	228
1.064	8.40	225
1.047	6.49	222
1.035	5.21	219
1.018	2.65	216
1.009	1.36	214

Muriatic acid combines with various bases, and forms a class of salts called *muriates*.

3. As far as is known at present, chlorine does not combine with carbon; but it unites with carbonic oxide, and forms an acid gas much heavier than any other gaseous body yet discovered, and called phosgen gas.*

4. When a current of chloric gas is made to pass over flowers of sulphur, a combination gradually takes place, the sulphur changes its colour, and a fine red liquid is formed, more than twice the weight of the sulphur employed. To this compound, originally discovered by Dr Thomson, Mr Davy has given the name of *sulphurane*.†

Sulphurane is a liquid of a fine red colour, between scarlet and crimson. By transmitted light it appears green. Its specific gravity is 1.623. It smokes very much, is very volatile, and has a smell similar to that of sea plants. Its taste is strongly acid, hot and bitter, affecting the throat with a painful tickling. It dissolves phosphorus readily, and forms an amber coloured liquid, which at last catches fire when left to spontaneous evaporation. When dropt into nitric acid it effervesces with considerable violence. With alcohol it becomes hot, and the smell of ether becomes perceptible. When dropt into water, it is gradually decomposed. Flocks of sulphur separate, and the water contains sulphuric and muriatic acids in solution. With ammoniacal gas it forms a solid red compound, which is decomposed and converted into sulphate and muriate of ammonia and sulphur, by the action of water. Such are the properties of this remarkable compound as far as they have been hitherto ascertained. We are not acquainted with the proportion of its constituents.

4. When phosphorus is introduced into chloric gas it takes fire spontaneously, and burns with a low white flame, and at the same time melts. Two substances are formed, one a clear liquid, the other a dry white matter which sublimes during the combustion. To this compound Mr Davy has given the name of *phosphorane*.

Phosphorane appears to possess some acid qualities, at least it combines with ammonia, and forms a white insoluble tasteless powder, very similar to silica in many of its properties. When phosphorane is digested in water, it is decomposed and converted into phosphoric and muriatic acids.

5. We are not yet acquainted with the combination of boracium and chlorine.

6. Chlorine readily combines with potassium, and forms the compound usually distinguished by the name of *muriate of potash*. Mr Davy proposes to give it the name of *potassane*.

When potassium is heated in chloric gas, it burns with great splendour, and potassane is formed. The same compound is obtained when potash and chlorine are brought in contact; but in that case the oxygen gas, which previously constituted one of the ingredients of the potash, is evolved. When potash and muriatic acid are brought in contact, water is formed, and the same compound obtained.

Potassane crystallizes in irregular cubes. Its taste is salt, and rather bitter. It dissolves in thrice its weight of cold water. Little altered by exposure to the air. In a red heat it melts, and loses about three per cent. of its weight. Not sensibly soluble in alcohol.

According to the experiments of Mr Davy, it is composed of
55.5 potassium,
44.5 chlorine.
100.0

7. The combination of chlorine and sodium has been known and in general use from the remotest ages, under the name of *common salt* or *muriate of soda*. Mr Davy has given it the name of *sodane*. It exists abundantly in sea water, from which it is obtained by evaporation. Mines of it occur also in different parts of the world. It crystallizes in cubes. Its taste is universally known, and is what, strictly speaking, is denominated salt. It dissolves in rather less than thrice its weight of water, and is nearly equally soluble in cold and hot water. It is insoluble in pure alcohol. It deliquesces somewhat when exposed to moist air. In a red heat it melts and loses about two per cent. of its weight. In a violent heat it evaporates.

Common salt, from the experiments of Mr Davy, is composed of
40.17 sodium,
59.83 chlorine.
100.00

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* This uncouth appellation has been before adverted to; it is scarcely possible to anticipate its reception into chemical writings generally, even if the fact of such a compound taking place is satisfactorily established. Coxe.

† These terminations of *ane* and *anea* do not convey any corresponding ideas of the peculiar combinations of chlorine; and I cannot but think Mr Davy would have acted more judiciously, in awaiting the final issue of the dispute as to the nature of muriatic and oxymuriatic acids; before he ventured, on his sole authority, to give them to the public, instead of merely proposing their adoption. *Ibid.*

8. As far as we know at present, chlorine has not the property of combining with ammonia.

9. Chlorine combines with barium, and forms the compound usually distinguished by the name of *muriate of barytes*. Mr Davy calls it *bariane*.

This salt crystallizes in four-sided prisms, whose bases are squares; but it is obtained more commonly in tables. It has a pungent and disagreeable taste; and, like all other preparations of barytes, is poisonous. It requires rather more than twice its weight of water to dissolve it. It is not sensibly soluble in pure alcohol. It is not altered by exposure to the air. In a red heat it melts, but is not decomposed.

10. It combines with strontium, and forms the compound usually distinguished by the name of *muriate of strontian*. Mr Davy calls it *strontiane*.

This salt crystallizes in long slender hexagonal prisms, usually so minute as to have the appearance of needles. It dissolves in rather less than its weight of cold water, while boiling water dissolves any quantity of it whatever. It dissolves in about 24 parts of pure alcohol. The crystals are not much altered by exposure to the air. When heated they undergo the watery fusion, and in a red heat are converted to a white powder.

11. Chlorine combines likewise with calcium, and forms the substance usually distinguished by the name of muriate of lime. Mr Davy calls it *calciane*. This salt is not easily procured in crystals, on account of its great solubility in water.[*] Its crystals are six-sided striated prisms, terminated by very sharp pyramids. Its taste is very bitter and pungent. At the temperature of 60° water dissolves four times its weight of this salt, and it dissolves any quantity whatever at the temperature of 100°. Alcohol seems capable of dissolving more than its own weight of this salt. This salt deliquesces very speedily when exposed to the atmosphere. When heated, it melts and loses its water of crystallization. In a violent heat it loses also a portion of its acid, and then has the property of shining in the dark. In that state, it is called the *phosphorus of Homberg*.

12. Magnium, as far as we know at present, does not combine with chlorine.

Mr Davy considers bariane, strontiane, and calciane, as composed of 32.9 of chlorine, combined with 71 barium, 46 strontium, and 21 calcium.

13. The compound of gold and chlorine, usually called *muriate of gold*, has not been accurately examined. It is a yellow coloured salt, having an acrid taste, and deliquescing in the air.

14. Neither are we well acquainted with *muriate of platinum*, which is in reality a compound of chlorine and platinum.

15. Silver combines with chloric acid in the proportion of 2 grains of the metal to $\frac{9}{10}$ths of a cubic inch of the gas. The compound is an insoluble powder, usually called *hornsilver*, or *muriate of silver*. Mr Davy calls it *argentane*.

This salt is easily obtained, by pouring common salt into a solution of nitrate of silver. It is at first a heavy white curdy precipitate, but it soon blackens when exposed to the air. It is insoluble in water. When heated to about 500°, it melts into a grey coloured semi-transparent mass, having some resemblance to horn, and formerly called *luna cornea*. When heated with potash, or when boiled with water and iron filings, it is decomposed, and the silver reduced to the metallic state. It dissolves in ammonia; it is likewise soluble in muriatic acid, and by that means may be obtained in octahedral crystals. One hundred parts of dry muriate of silver contain about 75.5 parts of pure silver.

Argentane is composed of
75.5 silver,
24.5 chlorine,

100.0

16. Chlorine combines in two proportions with mercury, and forms two compounds of great importance, distinguished by the names of *corrosive sublimate* and *calomel*. The first is a compound of two grains of mercury, and 1.05 cubic inches of chloric gas: the second contains the same quantity of mercury united to half the portion of gas.

Corrosive sublimate was known to the alchymists. A vast number of methods of preparing it have been made public. The most common method is to mix together equal weights of dry oxynitrate[†] of mercury, decrepitated common salt, and calcined sulphate of iron. One-third of a matrass or phial is filled with this mixture. The vessel is placed in a sand-bath, and gradually heated to redness. A cake of corrosive sublimate sublimes into the upper part of the vessel. It may be formed directly by dissolving red oxide of mercury in muriatic acid.

It has usually the form of a white semi-transparent cake composed of small prisms. Its specific gravity is 5.1398. Its taste is excessively acrid and caustic, and it leaves for a long time a very disagreeable styptic metallic impression on the tongue. It is one of the most virulent poisons known. It is soluble in about 20 parts cold and 3 parts boiling water. Alcohol dissolves nearly half its weight of it. It is not altered by exposure to the air. When heated it sublimes very readily, and the fumes are very dangerous when inhaled. It is soluble in sulphuric, nitric, and muriatic acids, decomposed by the alkalies, and precipitated of a brick red colour. The alkaline earths likewise decompose it, and ammonia forms with it a triple compound.

Calomel is prepared by triturating four parts of corrosive sublimate and three parts of mercury in a mortar, and then subliming the mixture in a matrass. It is a dull white mass, which becomes yellowish when reduced to powder. When slowly sublimed, it crystallizes in four-sided prisms, terminated by pyramids. Its specific gravity is 7.1758. It is insoluble in water. It is tasteless. When rubbed in the dark it phosphoresces. It requires a higher temperature to sublime it than oxymuriate of mercury. Chlorine and nitric acid convert it into oxymuriate corrosive sublimate.*

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[*] In the cold weather, this salt readily crystallizes; I have obtained it in perfect cubes, and have even preserved it during several summers by putting it in bottles, under oil of turpentine. Coxe.

[†] I attempted to preserve some beautiful crystals of this salt under oil of turpentine, as stated in the preceding note, with muriat of lime—but in a few weeks the salt and oil were both decomposed, the mercury was revived at the bottom of the phial, and water was formed. Coxe.

17. Chlorine combines in two proportions with copper, and forms two compounds, distinguished by the names of *cuprane* and *cupranea*. To form the first of these compounds, two grains of copper combine with 3.4 cubic inches of chloric gas.

Cuprane was discovered by Boyle, who gave it the name of *resin of copper*, from its colour. Proust afterwards discovered it anew, and gave it the name of *white muriate of copper*. It may be obtained by exposing copper filings to the action of chloric gas, by heating together two parts of corrosive sublimate, and one part of copper filings, by boiling copper filings in muriatic acid, or by exposing copper filings, partially immersed in muriatic acid, to the atmosphere. Cuprane is fusible in a heat just below redness; and in a close vessel it is not decomposed nor sublimed by a strong red heat; but when the air is admitted, it is dissipated in dense white fumes. It is insoluble in water, effervesces in nitric acid, is soluble in muriates, but is precipitated unaltered by the effusion of water. It is usually opake, of a dark brown colour, and of a confused hackly texture; but by slow cooling, it may be obtained light yellow, semitransparent, and crystallized in small plates.

Cupranea may be formed by heating cuprane in chloric gas; but it is most readily obtained by evaporating the deliquescent muriate of copper to dryness, at a temperature not much above 400° Fahrenheit. It is a yellow powder, decomposed by heat; absorbs water from the atmosphere, and is changed into deliquescent muriate. The constituents of these two compounds, according to the experiments of Mr John Davy, are as follows:

Cuprane of 60 copper + 32.77 chlorine = 92.77
Cupranea of 60 + 67.20 = 127.20

18. Iron likewise combines in two proportions with chlorine, forming two compounds, which have received the names of *ferrane* and *ferranea*.

Ferrane may be obtained by evaporating the green muriate of iron to dryness, and exposing the residue to a red heat in a glass tube, with a very narrow orifice. It has a greyish variegated colour, a metallic splendor, and a lamellar texture. It dissolves in water, and forms the green muriate of iron.

Ferranea may be obtained by burning iron wire in chloric gas. It sublimes during the combustion in the form of small brilliant iridescent plates. It dissolves in water, and the solution is identical with the red muriate of iron.

These two compounds, according to the experiments of Mr John Davy, are composed as follows:

Ferrane of 29.5 iron + 33.60 chlorine = 63.1
Ferranea of 29.5 + 55.50 = 85.0

19. Tin likewise combines with two doses of chlorine, and forms the two compounds distinguished by the names of *stannane* and *stannanea*.

Stannane may be obtained by heating together an amalgam of tin and calomel, or by evaporating the muriate of tin to dryness, and fusing the residue in a close vessel. It has a grey colour, a resinous lustre and fracture, and takes fire when heated in chloric gas. It melts at a heat below that of dull redness; when exposed to a strong heat, it is partially decomposed. It is converted into stannanea when heated with corrosive sublimate, nitre, red oxide of mercury, and hyperoxymuriate of potash.

Stannanea, or liquor of Libavius, may be obtained by heating together amalgam of tin and corrosive sublimate, or by mixing a concentrated solution of peroxide of tin in muriatic acid with sulphuric acid, and applying a moderate heat. This liquor smokes violently when exposed to the air. When mixed with about one-third of its weight of water, it crystallizes. Mr John Davy found, that it had the property of setting oil of turpentine on fire. According to the experiments of this gentleman, these two compounds are composed as follows:

Stannane of 55 tin + 33.4 chlorine = 88.4
Stannanea of 55 + 67.0 = 122.0

20. Lead, as far as is known, combines only in one proportion with chlorine. *Plumbane* may be obtained by decomposing the nitrate of lead by means of muriatic acid, and fusing the precipitate in a glass tube with a narrow orifice. It is the substance formerly well known under the name of horn lead. It is composed of 97.2 lead + 33.8 chlorine.

21. Zinc only forms one compound with chlorine. It has received the name of *zincane*. It may be obtained by evaporating to dryness the muriate of zinc, and fusing the residue in a glass tube. It is not volatile at a strong red heat in close vessels. When exposed to the air it deliquesces. It is composed of 34.5 zinc + 34.4 chlorine.

22. Bismuth combines readily with chlorine, and forms the substance formerly known by the name of *butter of bismuth*. It is now called *bismuthane*, and is composed of 67.5 bismuth + 34.20 chlorine.

23. Two grains of antimony absorb 3.1 cubic inches of chloric gas. The result is the compound formerly called *butter of antimony*. It was prepared by triturating together one part of antimony and two parts of corrosive sublimate, and distilling the mixture. The butter of antimony passes over in the state of a thick fatty mass, of a greyish white colour, and often crystallized in four sided prisms. It is very caustic, becomes coloured when exposed to the air, and melts at a moderate temperature. *Antimonane* (as this compound is called) is composed of 42.5 antimony + 34.6 chlorine.

24. Two grains of tellurium absorb 2.4 cubic inches of chloric gas. The product is a substance resembling butter of antimony in its appearance.

25. Two grains of arsenic absorb 3.6 cubical inches of chloric gas. The product is the substance usually called *butter of arsenic*. A dense, limpid, highly volatile fluid, a non-conductor of electricity, and of high specific gravity. When decomposed by water, it gives muriatic

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* If the doctrine of chlorine and its compounds should not be ultimately proved correct, we may consider Mr Murray's views of these two important salts as most probable. He regards them *both* as perfect muriats; the one of the red oxyd, the other of the black; the corrosive sublimate, or salt formed with the red or higher oxyd of mercury, requiring more muriatic acid to saturate it, than calomel, or the compound of the black oxyd requires. Both then, are strictly entitled to the name of muriat. The first is not an *oxymuriat*; nor is the last a *sub-muriat*. How then can they be sufficiently discriminated in medical prescriptions? for a mistake might prove fatal; and some distinction is therefore absolutely necessary. No terms appear to me better, than the adjuncts *corrosive* and *mild*, as heretofore. COXE.

acid, and white oxide of arsenic, similar, in this respect, to most of the combinations of chlorine with the metals. It is composed of 21.9 arsenic + 33.6 chlorine.

26. Manganese absorbs chloric gas, and forms a compound of a deep brown colour, and not volatilized at a dull red heat. It may be obtained by heating the dry muriate of manganese to redness. It is pink coloured, and composed of 28.4 manganese, + 33.6 chlorine.

27. Tungsten absorbs chloric gas, and forms an orange-coloured sublimate.

The remaining combinations of chlorine with metals are still unknown

Chap. VIII.

Of Compound Combustibles.

The compound combustibles are usually composed of carbon and hydrogen, or of carbon, hydrogen, and oxygen. They are very numerous, including almost all the animal and vegetable bodies. But the progress of the investigation of these bodies, and their importance in chemical investigations, is not such as to warrant their introduction here. We shall describe only those compound combustibles which are of importance as instruments of chemical analysis. These may be comprehended under the five following heads. 1. Alcohol. 2. Ethers. 3. Volatile oils. 4. Fixed oils. 5. Bitumens.

Sect. I. *Of Alcohol.*

The liquid called *alcohol*, or *spirit of wine*, is obtained when wine, beer, or other fermented liquors are subjected to distillation. The ancients were unacquainted with it. We do not know the discoverer of this liquid, but it was known to the alchymists, and introduced by them into pharmaceutical preparations.

It is by the distillation of fermented liquors that ardent spirits are obtained, and they receive various names according to the nature of the substance employed. Thus *brandy* is obtained from *wine*, *rum* from the fermented juice of the *sugar cane*, *whisky* and *gin* from the fermented infusion of *malt* or *grain*. Now, ardent spirits consist almost entirely of three ingredients; namely, water, pure spirit or alcohol, and a little oil or resin, to which they owe their flavour and colour. When these liquids are re-distilled, the first portion that comes over is a fine light transparent liquid, known in commerce by the name of *rectified spirits*. When as highly rectified as possible, the specific gravity of the liquid obtained does not appear to be less than 0.820, and is generally more. Alcohol, by this process, cannot be deprived of the whole of the water with which it is combined. The best method of getting rid of the water is to expose a quantity of the salt called *muriate of lime* to a red heat, to put it into a retort while still warm, and to pour over it a portion of alcohol of about 0.820, nearly equal to it in weight. The alcohol dissolves the salt, and much heat is evolved. This mixture is to be exposed to heat, and the alcohol distilled off. The salt retains the water, and the alcohol comes over of the specific gravity 0.791 at 68°, or 0.796 at 60°. In this state it is the strongest alcohol that can be procured. It is, therefore, called *pure*, or *absolute alcohol.*[*] The alcohol of commerce is never so strong as this; its specific gravity is seldom under 0.837.

Alcohol, thus procured, is a transparent liquid, colourless as water, of a pleasant smell, and a strong penetrating agreeable taste. When swallowed, it produces intoxication. It cannot be frozen in the greatest degree of cold to which it has been exposed, and it has been cooled down in thermometer tubes to —91°. It is very volatile, evaporating spontaneously at the common temperature of the atmosphere. When heated to 173½° it boils, and is converted into an elastic fluid, possessing the mechanical properties of air, but more than twice as heavy.

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[*] Alcohol may also be dephlegmated by pearl-ash: but it does not appear to be known, that the temperature of the air in which the dephlegmation is undertaken, has considerable influence on the facility of separating the water with which it is combined. We have been in the habit of preparing the article of the specific gravity 0.796 at 60° for more than twenty years, and have had frequent occasion to observe, that, in very cold weather, more water may be separated in one day, than in several weeks during the summer months. Alcohol of the above specific gravity, will (contrary to the general assertion) dissolve the resin copal with great facility, without the aid of heat, or any addition whatever; and hold it in suspension for any number of years: indeed, in the course of twenty-four hours, with repeated agitation, it will dissolve more of the resin than can be conveniently spread with a brush.

We have also dephlegmated alcohol by means of muriate of lime: but, as we never could obtain so perfect a dissolution of copal by alcohol prepared by this process, as by pearl-ash, it has appeared probable to us, that some of the muriatic acid is disengaged from the lime, and passes over with the alcohol during the distillation.

Our process for preparing alcohol being different in some particulars from those given in books, we lay it before the reader: any quantity of alcohol of the shops is introduced into a stoppered bottle; an equal weight of pearl-ash are heated to redness in an iron or other vessel during half an hour; the pearl-ash are then broken, and whilst hot, added to the alcohol: the bottle is frequently shaken until the pearl-ash are dissolved; when that is effected, the dissolved pearl-ash will remain at the bottom, and may be readily distinguished from the supernatant alcohol, by a visible line, which separates them. The supernatant alcohol is then to be decanted into another bottle, without suffering the solution of pearl-ash to follow. The solution of pearl-ash, with the alcohol which it contains, is to be poured into a glass funnel, having its orifice stopped by the finger; in a minute or two, what alcohol it contains will rise to the surface of the solution; the finger is then to be partly withdrawn, so as to allow the solution of pearl-ash to run in a gentle stream, by that means the line which separates the two liquids will not be disturbed; it will gradually subside to the finger when the orifice should be stopped, by passing the finger over it: the alcohol which is retained, may be added to that previously decanted into the bottle.

The same solution of pearl-ash is then to be boiled in a clean iron pot; when nearly dry it must be constantly stirred, to prevent it from adhering to the vessel; it is then to be heated red as before mentioned, and whilst hot, added to the before dephlegmated alcohol. If the alcohol with which the process is commenced is strong, the second addition of pearl-ash will not dissolve, but remain a soft magma at the bottom of the bottle: it should be suffered to remain for twenty-four or more hours, and frequently shaken during that period, after which it may be decanted, and the pearl-ash recalcined, and whilst hot returned into the alcohol.

After the process is repeated six or seven times, the pearl-ash if in powder, will roll about the bottle, on the latter being inclined; if the whole be mixed by strong agitation, after a few moments repose, the pearl-ash will subside to the bottom, and the supernatant alcohol will become diaphanous.

It combines with water in every proportion, and forms spirits of different degrees of strength according to the quantity of water present. The common spirits of commerce are nothing else than such combinations of alcohol and water. The proportion of alcohol present in these liquids is best judged of by their specific gravity. The specific gravity of pure alcohol is 0.796. That of water 1.000. Hence the lighter a spirit is, the stronger it is. Alcohol of 0.820 contains nearly $\frac{1}{10}$th of its weight of water; alcohol of 0.840 contains $\frac{17}{100}$ parts of water. What in this country is called *proof spirits*, is of the specific gravity 0.920. It was understood to be a mixture of equal bulks of alcohol and water. This, however, is not the case. It contains 0.52 of its weight of water. When spirits are weaker than 0.920, they are said to be *under proof;* when stronger, to be *above proof.* The spirits retailed in Scotland are almost always under proof, and sometimes indeed very weak.

Neither common air nor oxygen gas act upon alcohol at the common temperature, but in high temperatures the case is different. When alcohol is kindled in the open air, it burns all away without leaving any residuum. The flame is blue, and if the vapours emitted be collected, they are found to consist of carbonic acid and water, and the portion of water formed is greater than the whole of the alcohol consumed. When the vapour of alcohol is mixed with oxygen gas, it may be kindled by an electric spark, provided the temperature be above 70°, a detonation takes place, the alcohol is consumed, and water and carbonic acid formed. When alcohol is passed, in the state of vapour, through a red-hot porcelain or metallic tube, it is decomposed, and a variety of new products evolved. These are, 1. A great quantity of inflammable air, which, according to Saussure junior, consists of oxygen, hydrogen, carbon, and azote; 2. A little charcoal; 3. A little oil, partly in crystals, partly fluid; 4. A portion of water, holding in solution traces of acetic acid and ammonia; 5. A little of an acid which resembles the benzoic. By estimating the proportions of ingredients formed in these decompositions, chemists have endeavoured to ascertain the constituents of alcohol. The following is the result obtained by Saussure junior, who has lately published an elaborate set of experiments on the constituents of alcohol. It is composed of

Oxygen, . . .	37.85
Carbon, . . .	43.65
Hydrogen, . .	14.94
Azote, ...	3.52
Ashes, ...	0.04
	100.00

Alcohol has little action on the simple combustibles. On hydrogen and charcoal it seems to produce no effect. But it dissolves a little phosphorus and sulphur. If phosphureted alcohol be dropt into water, a lambent flame is observed playing on the surface of the liquid, and the phosphorus is disengaged.

Alcohol dissolves the fixed alkalies. It is by means of it, indeed, that these bodies are obtained in a state of purity. The earths are scarcely acted on by alcohol. It absorbs a quantity of nitrous gas, which cannot afterwards be expelled by heat.

The strong acids decompose alcohol. The rest combine with it, and form a set of compounds hitherto but little examined. It dissolves also a considerable number of salts, especially the acetates, muriates and nitrates. The sulphates are all insoluble in it. The colour of the flame of alcohol is tinged by various bodies. Thus nitrate of strontian tinges it purple; boracic acid and the cupreous salts tinge it green; muriate of lime gives it a light red colour; nitre and oxymuriate of mercury a yellow colour.

Sect. II. *Of Ethers.*

When alcohol is acted upon by several of the acids, a fragrant liquid is formed, to which the name of *ether* has been given. These ethers are named from the acid employed in forming them. As they differ in their properties, it will be requisite to describe them separately.

1. *Sulphuric Ether.*

This liquid was known about the end of the 15th century, and some of its properties were described by Boyle; but the attention of chemists was first drawn to it by a paper published in the Philosophical Transactions for 1730, by a German who called himself Dr Frobenius.

It may be obtained by distilling a mixture of equal parts of alcohol and sulphuric acid in a glass retort, to which a large receiver is attached. The ether condenses in the receiver. When first prepared, it contains some sulphurous acid, which is removed by putting some powdered chalk into it, and agitating repeatedly in a close

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It will then be proper to pass the alcohol through a filter, and after adding about one ounce of calcined and powdered alum to one pound of alcohol, (or, what will answer better, six or eight drops of sulphuric acid) to distil to dryness.

If the operator is acquainted with the manner of taking the specific gravity of liquids, he may assay the alcohol in that manner; if not, about half an ounce may be put into a phial, and a small piece of copal added; if the alcohol is of proper strength, an immediate action on the copal will be perceived; which will be accelerated by frequent agitation of the phial: if the dissolution does not take place, the same pearl-ash must be again heated, and the process repeated.

It frequently happens, that alcohol is contaminated by an empyreumatic oil, which it receives from the great heat employed in the first distillation. As long as it retains that empyreuma, it will not dissolve copal, whatever may be its strength, as we have repeatedly ascertained: in such cases, it will be necessary to distil it from some fresh burnt and powdered charcoal, which will effectually free it from all foreign odour.

Alcohol prepared in the above manner, will dissolve copal, without camphor, ammonia, or any additament whatever. All that is necessary is, to reduce the copal to a middling fine powder, pour on it the alcohol, and agitate it frequently during a day or two, when a varnish will be obtained, perfectly colourless, as strong as can be conveniently spread, and which possesses a lustre equal to the genuine Japan varnish. HEMBEL, jun.

phial, till the sulphurous acid smell is dissipated. The ether is then distilled a second time. It still retains a portion of alcohol, from which it may be freed by adding to it dry muriate of lime as long as it will dissolve that dry salt, and leaving the solution in a well corked phial. The muriate of lime dissolved in the alcohol gradually subsides, and the pure ether floats on the top. It may be decanted off.

Ether thus obtained is a limpid and colourless fluid like water. It has a peculiar and agreeable smell, and a hot pungent taste. Its specific gravity when pure is only 0.632 at 60°; but the ether of commerce is seldom lower than 0.775, owing to the alcohol which it contains.

It is so volatile that it cannot be poured from one vessel to another without considerable loss. When exposed to the open air, it disappears in a very short time. It boils at 98°, and in a vacuum at —20°. When evaporated, it produces a considerable degree of cold, so that water may be easily frozen by means of it even in summer. The specific gravity of the vapour of ether, according to Dalton, is 2.25, that of air being 1.00. When ether is exposed to a cold of —46°, it freezes and crystallizes.

Neither oxygen gas nor air produce any effect upon ether at the common temperature of the atmosphere; but when kindled in contact with these fluids, it burns with a strong white flame, giving out a great deal of light and heat. The products in this case are carbonic acid and water. It consumes, during its combustion, about seven times its bulk of oxygen, supposing the ether in the gaseous state. When mixed with oxygen gas in that proportion, it explodes very loudly when an electric spark is passed through the mixture. Various attempts have been made to estimate the constituents of ether by consuming it with oxygen gas, and ascertaining the products obtained. The following is the composition of ether, according to the experiments of Saussure junior.

Carbon, . . .	58.20
Hydrogen, . .	22.14
Oxygen, . . .	19.66
	100.00

These numbers indicate a much greater proportion of carbon and hydrogen, and a much smaller proportion of oxygen in sulphuric ether than in alcohol.

When ether is passed through a red hot porcelain tube, it is decomposed and converted into oil, charcoal, water, and a great proportion of heavy inflammable gas.

Ether combines only in a small proportion with water. Ten parts of that liquid dissolve about one part of ether. But alcohol unites with ether in any proportion.

Ether dissolves a little phosphorus and sulphur, but does not seem to act upon the other simple combustibles. It has no action on the metals, but revives those metallic oxides which readily part with their oxygen, as the oxides of gold and silver. It dissolves the muriate of gold, and the oxymuriate of mercury.

It does not appear to have any action on the alkalies or earths. It readily dissolves ammonia and nitrous gas.

Sulphuric acid seems capable of converting it into sweet oil of wine. Oxymuriatic acid sets it on fire spontaneously. The action of the other acids has not been ascertained.

It dissolves the fixed and volatile oils, and bitumens, but does not act upon gums.

From its constituents, as ascertained by Saussure, compared with those of alcohol, it is obvious that, during the formation of sulphuric ether, the alcohol is decomposed. This decomposition, according to Fourcroy and Vauquelin, is owing to the high temperature to which the alcohol is subjected, in consequence of being prevented from evaporating so easily by the sulphuric acid with which it is combined.

2. *Nitric Ether.*

This ether is mentioned by some of the older chemists, but its properties were almost unknown till it was lately examined by Thenard.

It may be formed by distilling a mixture of equal parts of alcohol and nitric acid of the specific gravity 1.283 in a retort, from which passes a tube that goes to the bottom of a tall glass jar half filled with a saturated solution of common salt in water. Several of these jars are connected together by tubes, and from the last a tube passes to convey the gaseous products to the water trough. The ether condenses on the surface of the liquid in these jars. It contains at first a little nitrous and acetic acids, from which it is purified by agitation with chalk in a close phial till it ceases to redden vegetable blues.*

Nitric ether thus prepared has a pale yellow colour, and a very strong ethereal odour. Its taste is strong and quite peculiar. It is rather heavier than alcohol, but much more volatile than sulphuric ether. Hence it only moistens bodies for a moment, and produces a considerable cold by its evaporation. The heat of the hand is sufficient to make it boil.

It dissolves in 48 parts of water, and communicates to that liquid an odour like that of apples. It dissolves in alcohol in any proportion. It burns with a white flame, and as brilliantly as sulphuric ether. When kept for some time, both nitric and acetic acids are evolved in it. The same acids make their appearance if the ether be heated, or if it be agitated in water. When brought in contact with a little of these acids, it instantly absorbs them, and acquires the property of reddening vegetable blues.

At the temperature of 70°, it quintuples the bulk of gases. At that temperature its vapour is capable of supporting a column of mercury 28.74 inches high. Hence its boiling point is obviously only a degree or two above 70°.

From the analysis of Thenard, the constituents of nitric ether are as follows:

Oxygen,	48.52
Carbon,	28.45
Azote,	14.49
Hydrogen,	8.54
	100.00

It is probable that it contains nitric acid ready formed, as one of its constituents, and that this acid is neutralized by the spirit, and thus prevented from acting on vegetable blues. It is obvious, from the preceding account of its properties, that nitric ether differs entirely from sulphuric ether in its nature.

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* Simply for the purpose of seeing this fluid, it is sufficient to employ Dr Black's method, of putting a quantity of nitric acid into a phial, above this a thin stratum of water, and over both a sufficient quantity of alcohol. Cork the phial tightly, and let it float in a tub of cold water. In a short time considerable action ensues; and in a few days the ether is found in considerable quantity, floating at the top. Coxe.

3. *Muriatic Ether.*

After the discovery of sulphuric and nitric ether, various attempts were made to procure muriatic ether, and different processes were suggested. Sometimes a mixture of alcohol and those metallic muriates that contain an excess of acid were distilled, and sometimes alcohol was saturated with muriatic acid gas and distilled. The nature of muriatic ether was almost unknown till a set of experiments was made on it by Gehlen in 1804. Thenard made another in 1807. To the labours of these two chemists we are indebted for all the knowledge we possess of this singular fluid.

It may be obtained by distilling in a retort equal bulks of alcohol and muriatic acid, both as strong as possible. From the retort a tube passes into a Woulfe's bottle, partly filled with water, and from the bottle another tube passes into the water trough. The whole of the ether formed assumes the gaseous form, if the temperature be as high as 70°, and may be collected in jars over water. A mixture of acid and alcohol weighing 30 ounces troy, yields more than 1200 cubic inches of this ethereal gas.*

This gas is colourless; it has a strong ethereal smell, and a sweetish taste. It produces no change on vegetable blues or lime water. Its specific gravity is 2.219, that of air being 1.000. At the temperature of 64° water absorbs its own bulk of this gas.

At the temperature of 52° it loses its gaseous form, and becomes liquid ether. It may be obtained in that state by passing it into a jar surrounded with ice. In its liquid state it is colourless like water, and has the same smell and taste as when gaseous. At the temperature of 41° its specific gravity is 0.874. It has no effect on vegetable blues. It is much more volatile than sulphuric or even nitric ether, assuming the gaseous form when not hotter than 64°. It burns with a green coloured flame, and a great quantity of muriatic acid is disengaged during the combustion. Thus it appears that muriatic acid is one of its constituents. But as the presence of that acid cannot be detected before combustion by the usual tests, it is obviously neutralized by the other constituents of the ether. Thenard has endeavoured to ascertain the constituents of this ether. The following are the proportions which he found:

Muriatic acid,	29.44
Carbon . .	36.61
Oxygen, . .	23.31
Hydrogen, .	10.64
	100.00

During the formation of muriatic ether, no gas whatever is evolved except the ether, and no new product appears except the ether itself. A portion of the muriatic acid disappears, and exactly the same portion makes its appearance again when the ether is burnt. These effects render it probable that muriatic ether is a combination of muriatic acid and alcohol. But if any dependence can be put in the above analysis, and in Saussure's analysis of alcohol, it is obvious that the alcohol in entering into the composition of muriatic ether has been altered, as its constituents are not in the same proportion as in pure alcohol.

4. *Acetic Ether.*

Acetic ether was discovered in 1759 by the Count de Lauraguais, who obtained it by distilling a mixture of alcohol and acetic acid. The process has been often repeated, and has been improved since its original discovery. Thenard has lately examined the properties of this ether.

He obtained it by distilling a mixture of strong acetic acid and alcohol in a retort, and repeating the distillation twelve times. No gas was found, nor any symptoms of the decomposition of either of the substances used exhibited. He then saturated the acid with potash, and by distilling the liquid off acetate of potash, he got the ether in a separate state.

Acetic ether is limpid and colourless. It has an agreeable odour of ether and acetic acid. It has a peculiar taste, bearing no resemblance to that of alcohol. It does not redden vegetable blues. At the temperature of 44½°, its specific gravity is 0.866. It boils at the temperature of 160°. It burns with a yellowish white flame, and acetic acid is developed. It undergoes no change by keeping. At the temperature of 62°, it requires more than seven times its weight of water to dissolve it. It seems, from the preceding account, to be a kind of combination of acetic acid and alcohol, substances which it seems have the property of neutralizing each other.

5. *Phosphoric Ether.*

From the late experiments of Boullay, it appears that ether may be formed also by means of phosphoric acid. This acid, of the consistence of honey, was put into a retort, and heated nearly to the temperature of boiling water. Alcohol was then introduced by means of a funnel passing to the bottom of the acid, and the mixture distilled. A liquid was obtained, which, when rectified off muriate of lime, yielded an ether possessing all the properties of sulphuric ether.

Besides these ethers, several others have been formed by means of other acids. Indeed, from the late experiments of Thenard, there is reason to believe that almost all the remaining acids may be made to combine with alcohol, and to form a liquid which might be denominated an ether, by distilling a mixture of alcohol, sulphuric acid, and the acid in question.

From the preceding detail, it appears that there are two kinds of ether essentially distinct: The first, consisting of sulphuric and phosphoric ethers, is formed by the decomposition of alcohol, and contains no acid. All the others contain an acid, and several of them seem to be combinations of an acid and alcohol. Alcohol appears to have the property of neutralizing acids, a property not suspected till lately; though several other vegetable substances seem to possess the same property.

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* The influence of time as a chemical agent is well evinced in the union of muriatic acid and alcohol. Although no immediate effect is perceived, yet if equal quantities are closely corked up in a phial, in the course of a few months a strong smell of muriatic ether is perceptible. So also in mixing together equal parts of muriatic acid and oil of turpentine in a close stopped phial, no effect is at first evident; but if the mixture is occasionally shaken, the oil is gradually blackened, and in about 12 or 14 months the smell of camphor is evident. COXE.

SECT. III. *Volatile Oils.*

The term *oil* is applied to a number of liquids, which, when dropt upon paper, sink into it, and make it semitransparent, or give it what is called a *greasy* stain. Chemists have divided them into two classes, *fixed* and *volatile*.

Volatile oils, called also *essential oils*, are distinguished by the following properties:

1. Liquid, often as liquid as water; sometimes viscid.
2. Very combustible.
3. An acrid taste and a strong fragrant odour.
4. Volatilized at a temperature not higher than 212°.
5. Soluble in alcohol, and imperfectly in water.
6. Evaporate without leaving any stain on paper.*

Volatile oils are almost all obtained from vegetables, and they exist in every part of plants, except the cotyledons of the seed, where they have never been found. They are sometimes obtained from plants by simple expression. But in general they are procured by mixing the vegetable substance containing them with water, and distilling. The oil comes over along with the water, and swims on its surface in the receiver.

They are very numerous, but a detailed account of each would not be interesting; a general account of their properties will be sufficient for our purpose.

Most of them are liquid. Some indeed are as liquid as water, as oil of turpentine. Some are viscid, and some of the consistence of butter, or even more solid.

Their colours are very various. Some are colourless like water. Some yellow, brown, blue, green, &c.

Their odours are so various as to defy all description. It is sufficient to say, that all the fragrance of the vegetable kingdom resides in volatile oils. Their taste is acrid, and sometimes they are even corrosive.

Their specific gravity is also various. Oil of turpentine, the lightest oil known, is 0.792, and oil of sassafras, the heaviest, is 1.094.

They evaporate very readily in the open air, diffusing their fragrant odour around. In close vessels, the heat necessary to distil them over appears to be greater. When cooled they congeal; but the temperature necessary to produce this effect varies in different oils. Some become solid at 50°, others not till cooled down to —17°. Several of them yield crystals of camphor and of benzoic acid when thus treated.

When exposed to the light, they acquire consistency, and assume a brown colour. Dr Priestley ascertained, that they imbibe oxygen with avidity. Probably these changes are connected with that absorption. By long exposure, several of them assume the form of resins.

When heated sufficiently, they take fire, and burn with a strong yellow flame, emitting a great quantity of smoke. The products of the combustion, besides the soot deposited, are water and carbonic acid.

When agitated in water, they render it milky, and communicate their peculiar odour. They dissolve in alcohol, ether and fixed oils.

They dissolve a little phosphorus and sulphur, but do not act on hydrogen or charcoal.

The alkalies and earths act but feebly on the volatile oils. The compounds formed have been called *saponules*. It is probable that they assume the form of resins before they combine with these bodies.

Sulphuric acid decomposes them, converting them first into a kind of resin, and at last into charcoal. Concentrated nitric acid sets them on fire. The diluted acid converts them into a kind of yellow resin.

They scarcely act upon metals; but they have a tendency to reduce some of the metallic oxides.

From the products obtained when the volatile oils are burnt, it has been concluded that they are compounds of carbon and hydrogen. But no exact analysis of any of them has hitherto been made.

SECT. IV. *Of Fixed Oils.*

The fixed oils, which are of so extensive utility, have been known from the remotest ages. They may be distinguished by the following properties.

1. Liquid, or easily become so when exposed to a gentle heat.
2. An unctuous feel.
3. Very combustible.
4. A mild taste.
5. Boiling point not under 600°.
6. Insoluble in water and alcohol.
7. Leave a greasy stain upon paper.

These oils, called also *fat*, or *expressed oils*, are obtained partly from animals, partly from vegetables, by simple expression. They occur chiefly in the seeds of bicotyledinous plants, and in the livers of animals. Whale oil, spermaceti oil, olive oil, and linseed oil, may be mentioned as examples of fixed oils.

Fixed oil is usually liquid, with a certain degree of viscidity. It has usually a yellowish or greenish tinge. Its taste is sweet, or nearly insipid. When fresh it has no smell.

Many solid bodies also are obtained from vegetables which have been hitherto confounded with the fixed oils, as palm oil, shea butter, &c. From the late experiments of Dr Bostock, these substances seem to approach the nature of wax rather more than that of fixed oils.

The fixed oils are all lighter than water. Their specific gravity varies from 0.968 to 0 892.

Fixed oil does not begin to evaporate till heated above 212°. As the heat increases, a pretty copious vapour may be seen to rise; but the oil does not begin to boil till heated nearly to 600°. It may be distilled over, but it is always altered by the process. Some water and acetic acid seem to be formed; heavy inflammable air is given out. The oil deepens in colour, and acquires a disagreeable taste and smell.

Fixed oil, when kindled, burns with a yellowish white flame, and is decomposed. The products are carbonic acid and water. When exposed to cold, they congeal or crystallize, and at the same time their bulk diminishes very considerably.

When exposed to the action of air, they undergo different changes, according to the nature of the oil. They gradually absorb oxygen and become solid. Now there are some that retain their *transparency* after they have become solid, while others assume the appearance of *tallow* or *wax*. Those that remain transparent are called *drying oils;* those that become opake, are called *fat oils.*

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* Many of them do, however, leave a stain upon paper, although not a greasy stain; hence the paper may be written upon, although discoloured. COXE.

The drying oils are used as a vehicle of paints and varnishes. Linseed, nut, poppy, and hempseed oils belong to this class. They acquire the property of drying oils more completely after they have been boiled. For some purposes it is common to set them on fire, and, after they have burnt for some time, to extinguish them, and continue the boiling till they have acquired the requisite viscidity. By this process, they lose the property of leaving a greasy stain upon paper, and acquire many properties in common with the resins. In this way, nut oil and linseed oil are prepared for printers ink. The oil, thus altered, still continues insoluble in water and alcohol, but it readily unites with fixed oil.

The *fat oils*, when exposed to the air, gradually become thick, opake, and white, and assume an appearance very much resembling wax or tallow. Olive-oil, oil of sweet almonds, of rape seed, and of ben, may be mentioned as examples of this class.

The action of the simple combustibles on the fixed oils is not very remarkable. Hydrogen has no action. Charcoal renders them purer when they are filtered through it; but separates from them with such difficulty that it cannot be employed for that purpose with advantage.

They dissolve a little phosphorus and sulphur when assisted by heat.

They are insoluble in water, alcohol, and ether; but they unite readily with each other, with volatile oils, with bitumens, and with resins.

The fixed alkalies combine with them readily, and form with them the important compound called *soap*. Potash forms with them only soft soap, while soda forms hard soap. The earths likewise and metallic oxides combine with the fixed oils, and form a kind of soap insoluble in water.

Sulphuric acid gradually decomposes the fixed oils, blackening their colour, and at last evolving charcoal. Nitric acid acts with still greater energy. When poured suddenly on the drying oils, it sets them on fire. When suddenly diluted, it converts them all into substances similar to resins or tallow.

The fixed oils oxidize some of the metals, as copper and mercury. They combine with various metallic oxides, as those of arsenic, lead, and bismuth; and are capable of forming with several, the viscid compounds called *plasters*.

They are liable, by keeping, to become *rancid*. They become thick, acquire a brown colour, an acrid taste, and a disagreeable smell. The oil, thus altered, converts vegetable blues to red, and of course contains an acid. This change is, at present, ascribed to a decomposition of the mucilaginous matter which is dissolved in all oils, or to the action of that matter in the oil.

When oils are burnt, the only products are carbonic acid and water. Lavoisier, from a set of experiments made in this way on olive-oil, deduced its composition as follows:

Carbon,	79
Hydrogen,	21
	100

But the experiments of Thenard and Gay Lussac, made in a different way, give its constituents as follows:

Carbon,	77.21
Hydrogen,	13.360
Oxygen,	9.427
	100

Many oils occur in the vegetable kingdom, which are intermediate in their properties between the fixed and volatile oils. Like the volatile oils, they are soluble in alcohol; but, like the fixed, they cannot be distilled over with that liquid. Hence they may be obtained by digesting the substance containing them in alcohol, and then separating the alcohol by evaporation.

Many oils are formed when animal and vegetable bodies are exposed to a heat above that of boiling water. These oils are called *empyreumatic*. They are usually dark-coloured, have an acrid taste and a disagreeable smell, and possess most of the properties of the volatile oils.

Sect. V. *Of Bitumens.*

The term *bitumen* has been often applied to all the inflammable substances which occur in the earth. But it is better to limit it to those *fossil bodies* only, which have a certain resemblance to oily and resinous substances. They may be divided into two classes. The first set possess nearly the properties of volatile oils; while the second set possess a peculiar character. The first class may be called *bituminous oils*. The second, *bitumens proper*.

1. *Bituminous Oils.*

Only two species of bituminous oils have been hitherto examined, namely, *naphtha* or *petroleum*, and *maltha* or *sea wax*.

1. Naphtha, or petroleum, is an oil of a brownish yellow colour. When pure, fluid as water, and pretty volatile. Its specific gravity varies from 0.730 to 0.878. It has a peculiar smell. When heated, it may be distilled over without alteration. It unites with alcohol, ether, volatile and fixed oils, and as far as is known, possesses all the characters of volatile oils.

When found in the earth pure, it is distinguished by the name of *naphtha;* when less fluid and darker coloured, it is called *petroleum*. When petroleum is distilled, naphtha is obtained from it.

2. Maltha, or sea-wax, is a solid substance found on the Baikal lake in Siberia. It is white, melts when heated, and on cooling assumes the consistence of white cerate. It dissolves in alcohol, and seems to possess the character of a solid volatile oil.

2. *Proper Bitumens.*

The true bituminous substances may be distinguished by the following properties:

1. They are either solid, or of the consistence of tar.
2. Their colour is usually brown or black.
3. They have a peculiar smell, or at least acquire it when rubbed. This smell is known by the name of the *bituminous odour*.
4. They become electric by friction, though not insulated.
5. They melt when heated, and burn with a strong smell, a bright flame, and much smoke.

6. They are insoluble in water and alcohol, but dissolve most commonly in ether and in fixed and volatile oils.

7. They do not dissolve in alkaline leys, nor form soap.

8. Acids have little action on them; the sulphuric scarcely any: the nitric, by long and repeated digestion, dissolves them, and converts them into a yellow coloured substance, soluble both in water and alcohol.

The pure bitumens at present known are three, namely, *asphaltum*, *mineral tar*, and *mineral caoutchouc*. United to resin, it forms a curious substance called *retinasphaltum*. United to charcoal, it forms the various species of pit-coal, so important as articles of fuel.

1. Asphaltum. This substance occurs in great abundance in the island of Trinidad, on the shores of the Dead Sea, in Albania, and in other places. Its colour is black, with a shade of brown, red, or grey. It is heavier than water. It is insoluble in acids, alkalies, water, and alcohol; but soluble in oils, petroleum, and sulphuric ether. See ASPHALTUM.

2. Mineral tar. This substance is found in Barbadoes and other places. It is named from its consistence and appearance. It seems to be a mixture of petroleum and asphaltum. Accordingly, when distilled, abundance of petroleum is obtained, of a brown colour, but very fluid.

3. Mineral caoutchouc is a singular substance, hitherto found only in Derbyshire. It is soft and elastic, not unlike common caoutchouc or Indian rubber. Its colour is dark brown, with a shade of green or red. It resists the action of almost all liquid menstrua. Neither alcohol, alkalies, nor nitric acid, affect it. Even oils and petroleum are incapable of dissolving it. When heated it melts, and continues afterwards of the consistence of tar. In that state it is soluble in oils. It burns with a bright flame and bituminous smell.

4. Retinasphaltum has hitherto been found only in Derbyshire, accompanying Bovey coal. Mr Hatchett discovered its nature. It has a pale brown ochre yellow colour, is very brittle, and breaks with a vitreous fracture. Its specific gravity is 1.135. When heated, it melts, smokes, and burns with a bright flame, and emits a fragrant odour. It is insoluble in water, but partially soluble in alcohol, potash, and nitric acid. It is composed of

Resin,	55
Asphaltum,	41
Earths,	3
	99

5. Pit-coal, one of the most useful of all the mineral productions, may be distinguished into three kinds. 1. Those that still contain vegetable principles, strictly so called, and thus give evident marks of their origin. Some yield *extractive*, others *resin*, besides charcoal and bitumen, which constitute the greatest part of their contents. The term *brown coal*, from their colour, has been applied to the greater number of coals belonging to this set. 2. *Black coal*. In them no vegetable principle can be detected; they are composed of bitumen and charcoal in various proportions, and are usually mixed with more or less of earthy matter. 3. *Glance coal*. In this set no vegetable principle, nor even bitumen, is to be found. The coal consists of charcoal pure, or contaminated with some earth. These coals have a great deal of lustre. They are heavy, and burn without emitting any flame or smoke, and only when heated to redness.

DIVISION II.

ON SECONDARY COMPOUNDS.

By the term *secondary compound* is meant, a combination of *primary compounds* with each other. Thus acids combine with alkalies and form *salts*; earths combine with fixed alkalies, and form *glass*; oils combine with fixed alkalies, and form *soap*. The secondary compounds, as far as we are at present acquainted with them, may be arranged under the five following classes:

1. Combinations of earths with each other, and with metallic oxides.
2. Combinations of earths with alkalies.
3. Combinations of acids with alkalies, earths, and metallic oxides.
4. Combinations of sulphureted hydrogen with alkalies, earths, and metallic oxides.
5. Combinations of oils with alkalies, earths, and metallic oxides.

These combinations may be distinguished by the following titles: 1. Combinations of earths; 2. Glass; 3. Salts; 4. Hydrosulphurets; 5. Soaps.

CHAP. I.

Of Combinations of Earths.

This subject is in some measure new, and has been but imperfectly investigated. The following observations are all that can be offered:

1. The earths require so violent a heat to melt them, that they are capable of resisting the most intense fires that we can raise. But in several cases the fusion is much facilitated by mixing various earths together. Thus alumina, in a pure state, is infusible, and so is a mixture of alumina and silica, or *pure clay*. But when lime is added to this substance, it melts with comparative facility. The oxide of iron also acts as a solvent when mixed with other earthy bodies, and greatly facilitates their fusion.

2. The three alkaline earths, lime, barytes, and strontian, resemble each other in their disposition to unite with the other earths. Like the alkalies, they combine with alumina and silica, but shew no affinity for magnesia, nor for each other.

3. Magnesia has a marked affinity for alumina, but for none of the other earths. When magnesia and alumina are present together in solutions, alkalies throw them down in combination.

4. Alumina has an affinity for all the alkaline earths. It has also an affinity for silica. These two earths are frequently found combined in nature.

5. Silica has an affinity for the alkaline earths, for alumina, and for zirconia. Silica enters into fusion with all the earths hitherto tried except alumina.

6. Several of the earths are capable of combining likewise with metallic oxides. Hitherto only six metals in the state of oxides have been found native combined with earths. These are, 1. chromium; 2. nickel; 3. copper; 4. zinc; 5. manganese; 6. iron.

Chromium constitutes the colouring matter of the *ruby*, in which mineral it is combined with alumina and magnesia. Nickel has been found only in one mineral, the *chrysoprase*, to which it gives a green colour. The same remark applies to copper, which has been found only in the *smaragdite*, and in a very small proportion. Zinc is sometimes found combined with silica in the mineral called *calamine*, which is frequently merely an oxide of zinc. The oxide of manganese is a very frequent ingredient in dark coloured stones, as *schorl*, *garnet*, &c. It is found also combined with barytes.

But it is the oxide of iron which constitutes by far the most common metallic constituent of minerals. No less than seven distinct colours, besides various shades, have been observed in minerals containing iron. These are *white*, *black*, *green*, *blue*, *red*, *yellow*, *brown*.

The oxides of iron melt when heated with barytes, lime, alumina, or silica, when they exceed the proportion of earth considerably. They render mixtures of silica and alumina fusible at a very low heat.

Chap. II.

Of Glass.

Silica, when mixed with the fixed alkalies and exposed to a strong heat, enters readily into fusion. It melts also when heated along with some of the alkaline earths, as lime, provided a little alumina be present. These mixtures are very ductile while in fusion, and may be readily moulded into any shape we please. If they be suddenly cooled below the temperature at which they become solid, they retain their transparency, and assume those peculiar properties which belong to the substance called *glass*. *Glass*, then, is a combination of the fixed alkalies, or alkaline earths with silica, either alone or conjoined with alumina, brought into complete fusion, and then suddenly congealed. Metallic oxides are sometimes added; they assist the fusion like the alkalies, and communicate frequently a peculiar colour to the vitreous mass.

When glass is in fusion, the substances which enter into its composition may be considered as combined with each other, so as to form a homogeneous mass similar to water holding a variety of salts in solution. If it be cooled down very slowly, the different tendency of the constituents to assume a solid form at peculiar temperatures, will cause them to separate successively in crystals; just as the salts held in solution in water assume the form of crystals as the liquid is slowly evaporated. But if the glass be quickly cooled down to the point of congelation, the constituents have not time to separate in succession, and the glass remains the same homogeneous compound as while in a state of fusion; just as would happen to a saline solution, if suddenly exposed to a cold capable of congealing it completely. Hence it appears that the vitreous quality depends entirely upon the fusibility of the mixture, and the suddenness with which it is cooled down to the point of congelation. The substance, though solid, is precisely the same as to its chemical composition as if it were still in fusion; the sudden cooling having fixed the constituents before they had time to assume a new arrangement.

All fusible mixtures of the earths proper with fixed alkalies, alkaline earths, or metallic oxides, may be made at pleasure to assume the form of glass, or the appearance which characterizes stone or porcelain, according to the rate of cooling; and glass may be deprived of its vitreous form, merely by fusing it, and cooling it down with sufficient slowness to enable the constituents to separate in succession. Sir James Hall found that glass (consisting of various earthy bodies) always loses its vitreous state, and assumes that of a stone, if more than a minute or two elapses while it is cooling down from complete fusion to the point at which it congeals.

There are different kinds of glass in common use for various purposes. The finest are *plate glass*, and *flint glass* or *crystal*. They are perfectly transparent, nearly colourless, heavy, and brilliant. They are composed of fixed alkali, pure siliceous sand or calcined flints, and litharge. *Crown glass* is made without lead; it consists of fixed alkali and siliceous sand, and is much lighter than flint glass. It has a distinct greenish tinge, from the oxide of iron present in the materials employed in making it. Sometimes too great a proportion of oxide of manganese is added, which gives it a purple colour. *Bottle glass* is the coarsest and cheapest kind. It consists chiefly of lime fused with silica and a little alumina, and contains so much iron and manganese as to give it a dark colour, and to diminish its transparency very much. It is much harder, stronger, and more difficultly fusible than the fine kinds of glass.

Glass answers well as a chemical vessel, as it is acted on only by a small number of re-agents. Fluoric acid corrodes it readily; so do the fixed alkalies when assisted by heat. Water, when long boiled in it, disengages some alkali from it, and occasions the separation of silica in the state of a white powder.

Chap. III.

Of Salts.

The word *salt* was originally confined to *common salt*, a substance which has been known and in common use from the remotest ages. The term was afterwards generalized by chemists, and applied to all bodies which are sapid, easily melted, soluble in water, and not combustible. At length it was confined to acids, alkalies, and the combinations of these bodies with each other. At present the term is applied to all the compounds which the acids form with alkalies, earths, and metallic oxides.

Chemists have agreed to denominate the salt from the *acids* which they contain. The alkali, earth, or metallic oxide, combined with that acid, is called the *base* of the salt. Thus Glauber salt, being a compound of sulphuric acid and soda, is called a *sulphate*, and soda is called the *base* of Glauber salt. Hence it follows, that there are as many genera of salts as there are acids, and as many individual salts, or species, as there are combinations of acids with a base. Silica and some of the metallic oxides do not appear capable of combining with acids. But to compensate this, there are some acids which combine with two bases at once, and form what are called *triple salts*. Thus *tartaric acid* combines at once with *potash* and *soda*. Some salts combine with an additional dose of their acid, and others with an additional dose of their base. The first render vegetable blues red, the second usually render them green. The first kind of salts are distinguished by prefixing to the usual name the preposition *super*, the second by prefixing the preposition *sub*. Thus *sulphate of potash*, denotes the salt in a state of perfect neutralization, without any excess either of acid or potash; *supersulphate of potash* is the same salt with an excess of acid; *subsulphate* of potash is the same salt with an excess of base.

As the different genera are denominated from the acids, it is obvious that there must be as many genera as there are acids. The termination of the names of these genera differs according to the acid which constitutes them. When the acid contains a maximum of oxygen, the termination of the genus is *ate ;* when it does not contain a maximum of oxygen, the termination of the genus is *ite*. Thus the salts which contain *sulphuric acid* are called *sulphates ;* those which contain *sulphurous acid* are called *sulphites*. This distinction is of some consequence, because the salts differ very much, according as the acid is saturated with oxygen or not. The *ites* are seldom permanent; when exposed to the air, they usually attract oxygen, and are converted into *ates*.

Every particular species of salt is distinguished by subjoining to the generic term the name of its base. Thus the salt composed of sulphuric acid and soda, is called *sulphate of soda*. Triple salts are distinguished by subjoining the names of both the bases connected by hyphens. Thus the salt composed of tartaric acid, potash, and soda, is called *tartrate of potash-and-soda*. Sometimes, instead of this, one of the bases is prefixed to the name by way of adjective. Thus, *soda muriate of rhodium* means the triple salt composed of muriatic acid, soda, and the oxide of rhodium. Sometimes the name of the base prefixed is altered a little ; as, *ammonia-sulphate of magnesia (sulphate of magnesia-and-ammonia ;) ferruginous sulphate of zinc (sulphate of zinc-and-iron.)*

The salts naturally divide themselves into two classes. Those which contain an alkali or earth for their base, derive their chief properties from the acids, and are properly enough characterised by the name of the acids applied to the names of the genera. But those which have for their base a metallic oxide, derive their characteristic properties from that base, and ought therefore to be arranged according to it. We shall therefore divide this Chapter into two Sections; in the first, we shall treat of the salts with alkaline and earthy bases; in the second, of the salts with metallic bases.

SECT. I. *Of Alkaline and Earthy Salts.*

As the genera of these salts (derived from their acids) are very numerous, it will be advantageous to the learner, if we subdivide them into sets according to their properties. This is attempted in the following Table.

I. Incombustible Salts.
a. Not altered when heated with charcoal.
1. Muriates.
2. Fluates.
3. Borates.
4. Phosphates.*
b. Decomposed without combustion when heated with charcoal.
1. Sulphates.
2. Carbonates.
c. Set fire to charcoal, or yield oxygen gas by heat.
1. Nitrates.
2. Nitrites.
3. Hyper-oxymuriates.
4. Arseniates.
5. *Molybdates.*
6. *Tungstates.*
7. *Chromates.*
8. *Columbates.*†

II. Combustible Salts.
a. Acids partially dissipated by heat, leaving salts in *ate*.
1. Sulphites.
2. Phosphites.
b. Acids entirely dissipated by heat, leaving the base and charcoal.
+ Acids partly sublimed unaltered.
1. Acetates.
2. Succinates.
3. Moroxylates.
4. Benzoates.
5. Camphorates.
++ Acids wholly decomposed
6. Oxalates.
7. Mellates.
8. Tartrates.
9. Citrates.
10. Kinates.
11. Saccolates.
12. Urates.
13. Sebates.
14. Malates.
15. Formiates.
16. Suberates.
+++ Anomalous.
17. Gallates.
18. Prussiates.

Let us take a view of these genera in their order.

GENUS I. *Muriates.*

The muriates are all soluble in water, and several of them likewise in alcohol. When mixed with sulphuric acid they effervesce, and white acrid fumes with the odour of muriatic acid are exhaled.

We are but imperfectly acquainted with these bodies. Many of the compounds hitherto considered as muriates, have been shewn by Mr Davy to be compounds of chlorine, and a metallic body. Thus *common salt* is a compound of chlorine and sodium. The following are the only salts which we know at present to be muriates.

Sp. 1. *Muriate of Ammonia.* This salt was named *sal ammoniac*, because it was found native near the temple of Jupiter Ammon in Africa. It is usually in the form of hard elastic cakes. But by solution and evaporation it may be obtained crystallized in long four-sided pyramids. It deliquesces a little when exposed to moist air.‡ It is soluble in about thrice its weight of water, and in about 75 parts of alcohol. When heated, it sublimes, without decomposition, in a white smoke.

Sp. 2. *Muriate of Magnesia.* This salt exists in sea-water. It is not easily crystallized, but when its solution, properly concentrated, is exposed to a sudden cold, it may be obtained in small needles. Its taste is very bitter, hot, and biting. It dissolves in about half its weight of water, and in about twice its weight of pure alcohol. When exposed to the air, it speedily deliquesces. A strong heat decomposes it. When dried in a high temperature, it is very caustic.

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‡ This is a point contested by Mr Murray; and as far as I have observed, I believe him correct. It is true, the common muriat of ammonia will, as I have experienced, deliquesce, not a little, but often very greatly; but this I believe arises from adventitious impurities, &c. The muriat, formed by direct union of the two constituent gases, I am disposed to think, is not in the least deliquescent. COXE.

* The phosphates are decomposed when violently heated with charcoal, but the temperature required is so high, that the decomposition cannot be effected in ordinary fires. Except the phosphate of ammonia, which is decomposed pretty easily.

† The nitrate and hyperoxymuriate of ammonia are combustible alone. They are completely dissipated when heated. The genera in italics are placed from analogy only.

Sp. 3. *Muriate of Ammonia-and-Magnesia.* This salt is obtained when the solution of the two last salts are mixed together. Its crystals are small and irregular, its taste bitter and ammoniacal. It dissolves in about six times its weight of cold water.

Sp. 4. *Muriate of Alumina.* This salt is always in the state of a supermuriate. It hardly crystallizes, being always either gelatinous or in the state of a white mass. Water dissolves about four times its weight of it. It speedily deliquesces in the air. Alcohol dissolves at least half its weight of this salt. When heated, it melts and loses its acid.

Sp. 5. *Muriate of Yttria.* This salt does not crystallize, but runs to a jelly. It melts in a gentle heat, and attracts moisture very rapidly from the atmosphere.

Sp. 6. *Muriate of Glucina.* This salt has a sweet taste, and readily crystallizes.

Sp. 7. *Muriate of Zirconia.* This salt is transparent, and crystallizes in needles, which effloresce in the air. It is very soluble in water and in alcohol. Heat decomposes it with facility.

The following Table exhibits the composition of these salts according to the most accurate experiments hitherto made:

	Constituents.		
Muriates of	Acid.	Base.	Water.
Ammonia	100	64.6	75.4
Magnesia	100	89.8	99.3
Alumina	100	100	135

The last species has not hitherto been analysed.

GENUS II. *Fluates.*

Most of these salts are but sparingly soluble in water, and hitherto they have been but superficially examined. When sulphuric acid is poured on them, they exhale acrid fumes, which readily act upon glass and corrode it.

Sp. 1. *Fluate of Potash.* This salt is hardly known. It is said to crystallize when pure. It has but little taste, dissolves readily in water, and melts when heated. It combines readily with silica, and forms a white powder, loose like chalk, containing an excess of acid.

Sp. 2. *Fluate of Soda.* This salt crystallizes in cubes. Its taste is bitter and astringent. It is sparingly soluble in water. When heated, it decrepitates and melts into a transparent globule.

Sp. 3. *Fluate of Ammonia.* This salt crystallizes, and may be sublimed without decomposition.

Sp. 4. *Fluate of Alumina.* This salt does not crystallize, but is easily obtained in the state of a jelly. Its taste is astringent, and it always contains an excess of acid.

The remaining fluates are insoluble in water.

Sp. 5. *Fluate of Magnesia.* When this salt contains an excess of acid, it may be obtained in dodecahedrons. Heat does not decompose this salt.

Sp. 6. *Fluate of Lime.* This salt occurs native in abundance, and is the only fluate that has been accurately examined. It is usually crystallized in cubes, sometimes in octahedrons. It has no taste, nor is it altered by exposure to the air. Its specific gravity is 3.15. When heated, it decrepitates and phosphoresces strongly. When strongly heated, it melts into transparent glass. According to Dr Thomson's analysis, it is composed of $32\frac{2}{3}$ acid and $67\frac{1}{3}$ lime.

Sp. 7. *Fluate of Barytes.* This is a white tasteless powder, not hitherto examined.

Sp. 8. *Fluate of Alumina-and-Soda.* This salt has been found in Greenland, and is called *cryolite* by mineralogists. Its colour is greyish white. It has some transparency. It breaks into cubic fragments. Its specific gravity is 2.950. It is brittle and softer than fluate of lime. It is composed of

Acid and water,	40
Soda,	36
Alumina	24
	100

Sp. 9. *Fluate of Silica.* Fluoric acid, as usually obtained, contains, in solution, a quantity of silica. When kept in vessels not completely shut, it deposites small rhomboidal crystals of silica.

GENUS III. *Borates.*

This genus has been very imperfectly examined. All the fluates, before the blow-pipe, melt into a glass. When boiled in diluted sulphuric acid, they yield small scales of boracic acid.

Sp. 1. *Borate of Potash.* This salt crystallizes in four-sided prisms. It has been very little examined.

Sp. 2. *Borate of Soda.* This salt may be formed by saturating borax with boracic acid. It is soluble in $2\frac{1}{2}$ times its weight of hot water.

Sp. 3. *Borax* or *Sub-borate of Soda.* This salt is the only one of the borates which has been accurately examined. It is brought from the East Indies, and has been in common use in Europe for ages. It seems even to have been known to the ancients. It crystallizes in hexangular prisms, but is usually in roundish semi-transparent lumps. Colour white. Specific gravity 1.740. Taste styptic and alkaline. Converts vegetable blues to green. Soluble in about twenty times its weight of cold water, but more soluble in hot water. When exposed to the air, it effloresces slowly and slightly. When heated, it melts, loses its water of crystallization, and is converted into a light porous substance called *calcined borax.* In a strong heat it melts into a transparent glass, still soluble in water. It is said to be composed of

Acid,	39
Base,	17
Water,	44
	100

Sp. 4. *Borate of Ammonia.* This salt forms permanent crystals, which resemble those of borax. Heat decomposes it.

Sp. 5. *Borate of Strontian.* This salt is a white powder, and contains an excess of base.

The remaining borates are insoluble in water.

Sp. 6. *Borate of Magnesia.* This salt may be obtained in small irregular crystals. It is soluble in acetic acid. Alcohol is said to decompose it. When heated, it melts, and is not decomposed.

Sp. 7. *Borate of Lime.* This is a white powder, hardly soluble in water, and tasteless.

Sp. 8. *Borate of Barytes.* An insoluble white powder, hardly examined.

Sp. 9. *Borate of Alumina.* Scarcely soluble, and not crystallizable.

GENUS IV. *Phosphates.*

The salts belonging to this genus, when heated before the blowpipe, melts into a globule of glass. They dissolve in nitric acid, without effervescence, and are precipitated from that solution by lime-water or ammonia. They amount to twelve.

Sp. 1. *Phosphate of Potash.* Of this salt there are two varieties, the *superphosphate*, long known, and the *phosphate*, not accurately discriminated till lately.

Variety 1. *Superphosphate.* This salt is formed by dissolving carbonate of potash in phosphoric acid till all effervescence cease, and then evaporating the solution. It crystallizes with difficulty in striated prisms. It is very soluble in water, and deliquesces when exposed to the air. When heated, it undergoes the watery fusion, loses its water of crystallization, and is reduced to dryness. In a high temperature it melts into a transparent glass.

Variety 2. *Phosphate.* This salt may be formed by saturating the superphosphate with potash, and exposing the mixture to heat in a platinum crucible. It is usually in the state of a white powder, tasteless, and insoluble in cold water though it dissolves in hot water. It melts easily into a transparent bead, which becomes opake on cooling. It dissolves in the nitric, muriatic, and phosphoric acids, and is not precipitated by alkalies; but when the solutions are concentrated, a precipitate falls.

Sp. 2. *Phosphate of Soda.* This salt is usually prepared by decomposing the superphosphate of lime from burnt bones with carbonate of soda. As sold by apothecaries, it is much contaminated by sulphate of soda. It crystallizes in rhomboidal prisms. Its taste is similar to that of common salt. It dissolves in four times its weight of cold water. In the air it effloresces. When heated, it undergoes the watery fusion; and, at a red heat, melts into a white enamel.

Sp. 3. *Phosphate of Ammonia.* This salt exists in urine. It is also prepared artificially in the same way as the last species. It crystallizes in four-sided prisms. Its taste is cooling, salt, and ammoniacal. It is soluble in four parts of cold water. When heated, it undergoes the watery fusion. In a strong heat the ammonia is disengaged, and the phosphoric acid melts into a glass.

Sp. 4. *Phosphate of Magnesia.* This salt may be obtained by mixing together concentrated solutions of phosphate of soda and sulphate of magnesia; in a few hours crystals of phosphate of magnesia are deposited. It crystallizes in six-sided prisms with unequal sides. It has little taste, dissolves in 15 parts of cold water, and falls to powder when exposed to the air. When heated strongly, it melts into a transparent glass.

Sp. 5. *Phosphate of Soda-and-Ammonia.* This salt, known by the name of *microcosmic salt*, may be obtained from urine. It possesses nearly the properties of a mixture of the two preceding species.

Sp. 6. *Phosphate of Ammonia-and-Magnesia.* This triple salt exists also in urine. Its crystals are four-sided transparent prisms, terminated by four-sided pyramids. It is tasteless; scarce soluble in water; and not liable to be altered by exposure to the air. In a strong heat, it loses its ammonia, and melts into a transparent glass.

The remaining phosphates are insoluble in water.

Sp. 7. *Phosphate of Lime.* This salt constitutes the basis of bones. It may be obtained by calcining bones, dissolving them in muriatic acid, and precipitating by ammonia. It is then in the state of a white powder; but it is found native, crystallized in six-sided prisms, and is distinguished among mineralogists by the name of *apatite*. It has no taste, is insoluble in water, and not altered by exposure to the air. A red heat does not alter it; but in a very violent temperature, it is converted into a kind of enamel. It dissolves in the strong acids without effervescence, and may be again precipitated by ammonia. The strong mineral acids decompose it partially, and convert it into *superphosphate of lime*, which is an acid liquid, which crystallizes in thin brilliant plates.

Sp. 8. *Phosphate of Barytes.* This is a white tasteless powder, which, in a violent temperature, melts into a grey enamel.

Sp. 9. *Phosphate of Strontian.* This is a white powder, insoluble in water, but soluble in phosphoric acid. Before the blowpipe, it fuses into a white enamel.

Sp. 10. *Phosphate of Alumina.* A white powder, but tasteless and insoluble in water.

Sp. 11. *Phosphate of Yttria.* A gelatinous mass, insoluble in water.

Sp. 12. *Phosphate of Glucina.* A white tasteless insoluble powder.

The following Table exhibits the constituents of the phosphates, according to the experiments of Richter.

Phosphate of	Acid.	Base.
Alumina . . .	100	53.6
Magnesia . . .	100	62.8
Ammonia . .	100	68.6
Lime	100	81
Soda	100	87.7
Strontian . . .	100	135.7
Potash . . .	100	164
Barytes . . .	100	222

GENUS V. *Phosphites.*

The salts belonging to this genus have been but little examined by chemists. When heated, they emit a phosphorescent flame. When strongly heated, they yield a little phosphorus, and are converted into *phosphates*.

Sp. 1. *Phosphite of Potash.* This salt crystallizes in four-sided prisms. Its taste is sharp and saline. It is soluble in three parts of cold water. It is not altered by exposure to the air.

Sp. 2. *Phosphite of Soda.* It crystallizes in rhomboids. Its taste is cooling and agreeable. It dissolves in two parts of cold water. It effloresces in the air. Before the blow-pipe, it gives out a fine yellow flame, and melts into a globule which becomes opake in cooling.

Sp. 3. *Phosphite of Ammonia.* It crystallizes in four-sided prisms. Its taste is sharp and saline. It dissolves in two parts of cold water. It deliquesces a little. When heated, it loses its base, emits phosphureted hydrogen gas, and phosphoric acid remains.

Sp. 4. *Phosphite of Ammonia-and-Magnesia.* This salt is sparingly soluble in water, and crystallizes.

Sp. 5. *Phosphite of Alumina.* This salt does not crystallize, but forms a glutinous mass, which dries gradually, and does not afterwards attract moisture. It is very soluble in water. Its taste is astringent.

The remaining phosphites are insoluble in water.

Sp. 6. *Phosphite of Magnesia.* This salt is usually in the state of a white powder, or of small four-sided prisms. It effloresces in the air. It is said to be soluble in 400 parts of cold water.

Sp. 7. *Phosphite of Lime.* This is a white tasteless powder, insoluble in water, but soluble in phosphorous acid, forming a superphosphite, which may be obtained in prismatic crystals by evaporation.

Sp. 8. *Phosphite of Barytes.* This is a white powder, hardly soluble in water unless there be an excess of acid.

GENUS VI. *Carbonates.*

This is one of the most important of the saline genera. When muriatic or nitric acid is poured on them, they effervesce, and give out carbonic acid. When fully saturated, they do not affect vegetable blues, but the alkaline *subcarbonates* convert vegetable blues to green.

Sp. 1. *Carbonate of Potash.* Of this salt there are two varieties, the *carbonate* and *subcarbonate.*

Variety 1. *Carbonate.* This salt may be formed by causing a current of carbonic acid to pass through a solution of potash, till the salt crystallizes. It crystallizes in rhomboidal prisms, with dihedral summits. It has a very slight alkaline taste, and still gives a green colour to vegetable blues. It is soluble in four parts of cold water. Alcohol scarcely dissolves it. Exposure to air does not alter it.

Variety 2. *Subcarbonate.* This salt is obtained by exposing the preceding to a strong red heat. It contains exactly one half of the acid contained in the carbonate. It is much more soluble in water; its taste is very alkaline and caustic; and when exposed to the air, it soon deliquesces and runs into a liquid. The potash of commerce is always in the state of a subcarbonate.

Sp. 2. *Carbonate of Soda.* Of this salt, like the preceding, there are two varieties.

Variety 1. *Carbonate.* This salt occurs native in Africa, and may be formed by passing a current of carbonic acid through a solution of soda, till it ceases to absorb any more. It runs into a hard solid mass, which is not altered by exposure to the air.

Variety 2. *Subcarbonate.* What is called carbonate of soda in commerce, is nothing else than this salt. Its crystals are octahedrons, having their apexes truncated, or more commonly flat rhomboidal prisms. It dissolves in two parts of cold water. When exposed to the air, it effloresces and falls to powder. When heated, it undergoes the watery fusion, and melts in a red heat into a transparent liquid.

Sp. 3. *Carbonate of Ammonia.* Of this salt, also, there are at least two varieties.

Variety 1. *Carbonate.* This salt may be obtained by passing a current of carbonic acid through the subcarbonate dissolved in water. It crystallizes in six-sided prisms; has no smell, and much less taste than the subcarbonate. When heated, it sublimes, and is decomposed.

Variety 2. *Subcarbonate.* This salt crystallizes, but the crystals are small and irregular. Its smell and taste are similar to those of ammonia, though weaker. It is lighter than water. It is soluble in less than twice its weight of water. From the experiments of Davy, it would appear that there are different varieties of this salt, containing various proportions of acid, according to the temperatures in which it has been prepared.*

Sp. 3. *Carbonate of Ammonia-and-Magnesia.* This salt may be formed by mixing together aqueous solutions of its two constituents. Its properties have not been examined.

The remaining carbonates are insoluble in water.

Sp. 5. *Carbonate of Magnesia.* Of this salt there are likewise two varieties.

Variety 1. *Subcarbonate.* This is a light white powder, constituting the magnesia of commerce.

Variety 2. *Carbonate.* It may be formed by diffusing the preceding variety in water, and passing a current of carbonic acid through the liquid. It crystallizes in six-sided transparent prisms. It has little taste. It dissolves, when in crystals, in 48 parts of cold water. It effloresces in the air, and falls to powder.

Sp. 6. *Carbonate of Lime.* This salt, under the names of marble, chalk, limestone, calcareous spar, &c. exists in great abundance in nature. It crystallizes in rhomboidal prisms, with angles of 101½° and 78½°; and no less than 616 different varieties of form have been observed and described by mineralogists. It is tasteless, insoluble in water, but soluble in a small proportion by means of carbonic acid. When heated strongly, it loses its acid, and the escape of the acid is greatly facilitated by the presence of vapour. When suddenly heated, it melts without losing its acid, and assumes a form bearing some resemblance to granular limestone.

Sp. 7. *Carbonate of Barytes.* This salt is found native, and distinguished by mineralogists by the name of Witherite. It crystallizes in double six-sided and four-sided pyramids. It is tasteless, insoluble in water, but poisonous. It is not altered by exposure to the air. When made up into a ball with charcoal, and violently heated, it loses its acid.

Sp. 8. *Carbonate of Strontian.* This salt also occurs native, usually in semi-transparent striated masses, with a greenish tinge. It is tasteless, insoluble in water, and not altered by exposure to the air. When violently heated, it loses its acid.

Sp. 9. *Carbonate of Alumina.* Water, containing carbonic acid gas, dissolves a little alumina; but when the alumina is precipitated and dried. it appears. from the experiments of Saussure, that it loses its acid. Carbonate of alumina, then, cannot exist in a dry state.

Sp. 10. *Carbonate of Yttria.* A white, tasteless, insoluble powder.

Sp. 11. *Carbonate of Glucina.* A white, soft, tasteless powder, with a greasy feel.

Sp. 12. *Carbonate of Zirconia.* A white tasteless powder.

The following Table exhibits a view of the composition of these salts, as far as it has been ascertained.

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* This seems scarcely compatible with the view he has taken of definite proportions in chemical compounds. COXE.

Carbonate of	Acid.	Base.	Water.
Ammonia, . .	100	33.9	44.6
Magnesia, . .	100	50	50
Potash, . . .	100	95.3	37
Soda, . . .	100	97.4	59
Lime, . . .	100	122	
Strontian, . .	100	231	
Yttria, . . .	100	305.5	150
Barytes, . .	100	363	

The subcarbonates appear to contain just one half of the acid which exists in the carbonates.

GENUS VII. *Sulphates.*

This genus of salts has been long known, and very carefully examined. Most of the salts in it crystallize. Their taste is usually bitter. They are insoluble in alcohol, and precipitated from water by alcohol. When heated to redness, along with charcoal, they are converted into sulphurets. All their solutions yield a white precipitate, insoluble in cold sulphuric acid, when mixed with muriate of barytes.

Sp. 1. *Sulphate of Potash.* Of this salt there are two varieties.

Variety 1. *Sulphate.* This salt is usually to be found in considerable quantity in the potash of commerce. The crystals are small, irregular, hard, and firm: usually six-sided prisms. The taste is a disagreeable bitter. It dissolves in about 16 times its weight of cold water. It is not altered by exposure to the air. In a red heat it melts, and loses about 1½ per cent. of its weight.

Variety 2. *Supersulphate.* This salt may be obtained by dissolving the preceding in sulphuric acid, and evaporating. Its crystals are long slender needles, or six-sided prisms. Its taste is acid, and it reddens vegetable blues. When heated, it melts, and assumes the appearance of oil. A strong red heat is necessary to drive off the excess of acid, and convert it into *sulphate.*

Sp. 2. *Sulphate of Soda.* This salt is often called Glauber's salt, from the name of the discoverer of it. There are two varieties of it, like the preceding.

Variety 1. *Sulphate.* This salt crystallizes in six-sided transparent prisms, terminated by dihedral summits. The sides of the prisms are usually channeled. Its taste, at first, has some resemblance to that of common salt, but it soon becomes disagreeably bitter. It dissolves in less than thrice its weight of cold water, and in less than its weight of boiling water. When exposed to the air, it loses its water, effloresces, and falls to powder. The loss of weight is about 0.56 parts.[*] When heated, it undergoes the watery fusion. In a red heat it melts, and, according to Kirwan, loses part of its acid.

Variety 2. *Supersulphate.* This salt may be obtained by dissolving the preceding variety in sulphuric acid, and evaporating the solution. It crystallizes in large transparent rhombs; which effloresce in the air, and easily part with their excess of acid.

Sp. 3. *Sulphate of Ammonia.* This salt crystallizes in small six-sided prisms. It has a sharp bitter taste; is soluble in twice its weight of cold water, and in its weight of boiling water. When exposed to the air, it slowly attracts moisture. When heated, it decrepitates, then melts, and sublimes with some loss of its alkali. When heated nearly to redness, the greatest part of it is decomposed.

Sp. 4. *Sulphate of Magnesia.* This salt was long known by the name of *Epsom salt,* because it exists in the spring at Epsom near London. It exists also in sea water. It crystallizes in regular four-sided prisms, surmounted by four-sided pyramids or dihedral summits. The crystals refract doubly. Its taste is intensely bitter. It dissolves in its own weight of cold water. In the air it effloresces. When heated, it undergoes the watery fusion, and before the blow-pipe melts with difficulty into an opake vitreous globule.

Sp. 5. *Sulphate of Potash-and-Ammonia.* This salt crystallizes in brilliant plates. Its taste is bitter, and it is not altered by exposure to the air.

Sp. 6. *Sulphate of Potash-and-Magnesia.* This salt crystallizes in rhomboidal prisms, and is not altered by exposure to the air.

Sulphate of Soda is also capable of forming triple salts with ammonia and magnesia.

Sp. 7. *Sulphate of Magnesia-and-Ammonia.* This salt crystallizes in octahedrons. Its taste is acrid and bitter. It is decomposed by heat, and is less soluble in water than either of its constituents.

Sp. 8. *Sulphate of Alumina.* This salt crystallizes in thin plates, soft and pliant, and of a pearly lustre. Its taste is astringent. It is very soluble in water, and crystallizes with difficulty.

Sp. 9. *Alum.* This is a triple salt, of which there are four varieties, namely, 1. *Sulphate of alumina-and-potash;* 2. *Sulphate of alumina-and-ammonia;* 3. *Supersulphate of ammonia-and-potash;* 4. *Supersulphate of alumina-and-ammonia.* The two last, (especially the 3d,) constitute the *alum* of commerce; the two first have been called *alum saturated with its earth,* or *aluminated alum.*

The composition of common alum was first ascertained by Vauquelin. It crystallizes in regular octahedrons. It is white, and semitransparent. Its taste is sweetish and astringent, and it reddens vegetable blues. It dissolves in about 16 parts of cold water. In a gentle heat it undergoes the watery fusion, and by continuing the heat, it loses about 44 per cent. of water, and is called *calcined* or *burnt alum.* In a violent heat, a portion of the acid is converted into sulphurous acid and oxygen gas. This salt, according to the analysis of Vauquelin, is usually composed of

Sulphuric acid,	30.52
Alumina, . .	10.50
Potash, . . .	10.40
Water, . . .	48.58
	100.00

Alum sometimes contains a little sulphate of iron mixed with it, which injures its qualities as a mordant.

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[*] This fact may be advantageously employed by our army and navy surgeons. In the state of complete efflorescence, this useful and much employed purgative is a perfectly dry powder, which can be preserved in bottles, or packed away in paper, without any risk of its doing injury to the other medicines, or to surgical instruments; a circumstance by no means unfrequent in its common state. It moreover occupies only about one half the original bulk and weight; a point of some importance, where much of it is employed, as it will give room for other articles. It ought therefore to be rendered necessary for those who supply our army and navy, to prepare this article in its effloresced state, by driving off its water of crystallization. COXE.

The *sulphates*, or two first varieties, may be formed by boiling alumina in a solution of alum. They are tasteless powders, insoluble in water, and not altered by exposure to the air.

Sp. 10. *Sulphate of Yttria.* This salt crystallizes in flat six-sided prisms. It is not altered by exposure to the air. Its taste is astringent and sweet. It has an amethyst red colour, and dissolves in about 30 parts of cold water. At a red heat it is perfectly decomposed.

Sp. 11. *Sulphate of Glucina.* This salt is colourless. It crystallizes in needles. Its taste is very sweet, and somewhat astringent. It is very soluble in water, and the solution does not readily crystallize. When heated, it undergoes the watery fusion, and in a red heat, is completely decomposed.

Sp. 12. *Sulphate of Zirconia.* This salt is usually in the form of a white powder; though it may be obtained also crystallized in needles. It is tasteless, and insoluble in water; not altered by exposure to the air, and easily decomposed by heat.

Sp. 13. *Sulphate of Lime.* This salt occurs native, and is distinguished by the names of *gypsum* and *selenite.* It is found crystallized in octahedrons, six-sided prisms, and in lenses. It has little or no taste. It dissolves in about 460 parts of cold water. It is not altered by exposure to the air. It dissolves in sulphuric acid. When heated, it loses its water of crystallization. When mixed with a little lime, it is much used under the name of *plaster of Paris*, for forming casts, moulds, &c.

Sp. 14. *Sulphate of Barytes.* This salt is found native, and distinguished by the names of *ponderous spar*, *heavy spar*, *baroselenite.* It occurs crystallized in tables, with bevelled edges, in four-sided prisms, &c. It is white, tasteless, insoluble in water, but soluble in hot sulphuric acid. It melts, when strongly heated, into a white opake globule. When made into a cake with flour, and heated to redness, it is phosphorescent.

Sp. 15. *Sulphate of Strontian.* This salt, like the preceding, occurs native in considerable quantity. It is crystallized in rhomboidal prisms. It is white, tasteless, insoluble in water, but soluble in hot sulphuric acid. In most of its properties it resembles the preceding salt, but its specific gravity is much less. The specific gravity of sulphate of barytes is at least 4.3, while that of sulphate of strontian does not exceed 3.66.

The following Table exhibits the composition of the different sulphates, as far as it has been ascertained.

Sulphate of	Acid.	Basc.	Water.
Ammonia	100	26.05	57
Magnesia	100	47.36	182.8
Lime	100	72.41	55.8
Soda	100	79.34	246.6
Potash	100	112.35	20
Strontian	100	138	
Barytes	100	194	

Genus VIII. *Sulphites.*

The sulphites may be formed by passing a current of sulphurous acid gas through water, holding the different bases in solution or suspension. They have a disagreeable sulphureous taste. When heated, they emit sulphurous acid and water, and at last sulphur, and are converted into sulphates. When they are exposed to the air in a state of solution, they are also gradually converted into sulphates.

Sp. 1. *Sulphite of Potash.* This salt crystallizes in rhomboidal plates, white, and semitransparent. Its taste is penetrating and sulphureous. It dissolves in its own weight of cold water. In the air it loses about two per cent. of its weight, and is very slowly altered; at least in six months it still contained nearly the usual proportion of sulphurous acid. Nitric acid speedily converts it into sulphate of potash.

Sp. 2. *Sulphite of Soda.* This salt crystallizes in flat four-sided prisms. It is white and transparent. Its taste is cool and sulphureous. It dissolves in four times its weight of cold water. In the air it effloresces, and is converted into sulphate. When heated it undergoes the watery fusion.

Sp. 3. *Sulphite of Ammonia.* It crystallizes in six-sided prisms. Its taste is cool and penetrating, and it leaves a sulphureous impression in the mouth. It dissolves in its own weight of cold water. When exposed to the air it attracts moisture, and is soon converted into sulphate When heated, a little ammonia is disengaged, and the salt then sublimes in the state of *supersulphite of ammonia.*

Sp. 4. *Sulphite of Magnesia.* It crystallizes in the form of depressed tetrahedrons. It is white and transparent Its taste is mild, but it leaves a sulphureous impression in the mouth. When exposed to the air, it becomes opake, and is very slowly converted into sulphate. It dissolves in 20 parts of cold water. When heated, it becomes ductile like gum, and loses 45 per cent. of its weight.

Sp. 5. *Sulphite of Ammonia-and-Magnesia.* This salt crystallizes, and is less soluble in water than either of its constituents.

Sp. 6. *Sulphite of Lime.* This salt is in the state of a white powder, or if an excess of acid be added, it crystallizes in six-sided prisms, terminated by six-sided pyramids. It has little taste, dissolves in about 800 parts of water, and in the air effloresces very slowly, its surface being changed into sulphate.

Sp. 7. *Sulphite of Barytes.* This salt, like the preceding, may be obtained in crystals, by adding an excess of acid. It crystallizes in needles. It is tasteless, and nearly insoluble in water.

Sp. 8. *Sulphite of Alumina.* This salt does not crystallize. It is a white soft powder, with an earthy and sulphureous taste. It is insoluble in water, and when exposed to the air, it is slowly converted into sulphate.

The following Table exhibits the constituents of the sulphites, as far as they have been ascertained.

Sulphites of	Acid.	Base.	Water.
Magnesia	100	41	115
Ammonia	100	48.3	18.3
Soda	100	58	164
Lime	100	97.9	10.5
Potash	100	125	4.6
Alumina	100	137.5	75
Barytes	100	151	5.1

GENUS IX. *Nitrates.*

All the salts belonging to this genus are soluble in water, and crystallize by cooling. When heated to redness, and charcoal powder thrown over them, a violent combustion is produced. Sulphuric acid disengages from them fumes of nitric acid. When heated, they are decomposed, and yield at first oxygen gas.

Sp. 1. *Nitrate of Potash, or Nitre.* This salt, which is of great importance, is found in warm climates, on the surface of the earth. It is collected and purified by solution and crystallization. Its crystals are six-sided prisms, terminated by six-sided pyramids. Its taste is sharp, bitterish, and cooling. It is very brittle. It dissolves in seven parts of cold water, and in less than its own weight of boiling water. Pure alcohol does not dissolve it. In a red heat it melts, and congeals into an opake mass, which has been called *mineral crystal.* When kept melted, it gives out about the third of its weight of oxygen gas. It detonates most violently with charcoal. This salt constitutes the principal ingredient of gunpowder, which is a mixture of about 76 parts nitre, fifteen charcoal, and nine sulphur. The constituents are ground to a fine powder, and then mixed together with great care. The goodness of the powder depends upon the intimate mixture. Those kinds of charcoal are pitched upon which absorb the least moisture from the air.[*]

Sp. 2. *Nitrate of Soda.* This salt crystallizes in transparent rhombs, differing but little from cubes. It has a cool sharp taste, and is rather more bitter than nitre. It dissolves in three parts of cold water, and in less than its weight of boiling water. When exposed to the air, it rather attracts moisture. Its phenomena with combustibles and heat are the same as those of the preceding species.

Sp. 3. *Nitrate of Ammonia.* This salt crystallizes in six-sided prisms, terminated by six-sided pyramids. It has a very acrid, bitter, disagreeable taste. It dissolves in twice its weight of cold water, and in half its weight of boiling water. In the air it very speedily deliquesces. When heated, it undergoes the watery fusion; but even after the water is driven off, it continues liquid at the temperature of about 400°, boils, and is decomposed, being converted into water and *nitrous oxide* gas, in the proportion of about four parts gas to three parts water. When heated nearly to redness, it burns with a kind of explosion. Hence it was formerly called *nitrum flammans.*

Sp. 4. *Nitrate of Magnesia.* This salt crystallizes in rhomboidal prisms, or small needles. Its taste is very bitter and disagreeable. It is soluble in little more than its weight of cold water. In the air it deliquesces. When heated, it undergoes the watery fusion, and speedily assumes the form of a white powder. It scarcely detonates with combustible bodies.

Sp. 5. *Nitrate of Lime.* This salt crystallizes in six-sided prisms, terminated by long pyramids. Its taste is very acrid and bitter. It dissolves in about the fourth part of its weight of cold water, and boiling water dissolves any quantity of it whatever. Boiling alcohol dissolves its own weight of it. It speedily deliquesces in the air. When heated, it readily undergoes the watery fusion. When deprived of its water of crystallization, it often has the property of shining in the dark. In this state it is called *Baldwin's phosphorus.*

Sp. 6. *Nitrate of Barytes.* This salt crystallizes in regular octahedrons, or in small brilliant plates. Its taste is hot, acrid, and austere. It is soluble in about twelve parts of cold water. When thrown upon burning coals, it decrepitates, and is converted into a dry mass. When strongly heated, the whole of its acid is dissipated, and pure barytes obtained.

Sp. 7. *Nitrate of Strontian.* This salt crystallizes in regular octahedrons, not unlike the crystals of nitrate of barytes. It has a strong, pungent, cooling taste. It is soluble in its own weight of cold water, and in little more than half its weight of boiling water. It is insoluble in alcohol. It deflagrates on hot coals. In a crucible it melts when heated. At a red heat it gives out its acid, and pure strontian remains behind. Combustibles thrown into it when red hot, burn with a lively red flame.

Sp. 8. *Nitrate of Ammonia-and-Magnesia.* This salt crystallizes in fine prisms. It has a bitter, acrid, ammoniacal taste. It dissolves in about eleven parts of cold water. In the air it gradually attracts moisture, and deliquesces.

Sp. 9. *Nitrate of Alumina.* This salt crystallizes with difficulty into thin soft plates, which have but little lustre. It has an acid and astringent taste, is very soluble in water, and soon deliquesces when exposed to the air. When evaporated, it is readily converted into a gummy mass, of the consistence of honey. It is easily decomposed by heat.

Sp. 10. *Nitrate of Yttria.* This salt scarcely crystallizes. Its taste is sweet and astringent. It speedily deliquesces in the air.

Sp. 11. *Nitrate of Glucina.* This salt may be obtained in the state of a powder, but not in crystals. Its taste is sweet and astringent. It is very soluble in water, and speedily deliquesces in the air.

Sp. 12. *Nitrate of Zirconia.* This salt does not crystallize, but may be obtained in the state of a viscid mass, which dries with difficulty. It has an astringent taste. It is very sparingly soluble in water, and seems, indeed, to be partially decomposed by that liquid. When heated, it readily parts with its acid, and is decomposed.

The following Table exhibits the composition of the nitrates, as far as has been ascertained.

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[*] It is said that the charcoal of any kind of wood is of equal utility in making gunpowder, if it is prepared by distilling the wood in close iron cylinders; by which a great quantity of impure acetic acid is also obtained; and which may be advantageously employed in many processes. COXE.

Nitrate of	Acid.	Base.	Water.
Ammonia	100	40.38	35.1
Magnesia	100	47.64	
Lime	100	55.70	18.7
Soda	100	73.43	
Strontian	100	116.86	105.3
Potash	100	117.7	8.1
Barytes	100	178.12	34.3

GENUS X. *Nitrites.*

When the crystallized nitrates are exposed to a sufficient heat, they give out oxygen gas. If the process be stopped in time, the salts still continue neutral. But the nature of the acid is obviously changed, as it has lost oxygen. Hence by this process the nitrates are converted into nitrites. The properties of the nitrites have not hitherto been investigated, except the nitrite of potash, examined by Bergman and Scheele. It deliquesces when exposed to the air, and gives out nitrous fumes, when treated with any acid, even the acetic.

GENUS XI. *Hyperoxymuriates.*

This genus of salts was discovered by Berthollet. But except the first species, all the rest were nearly unknown till examined by Chenevix in 1802. They are formed by passing a current of oxymuriatic acid through the bases dissolved in water. When heated nearly to redness, they give out oxygen gas, and are converted into muriates. When mixed with combustibles and heated, triturated, or struck upon an anvil, they detonate with great violence.

Sp. 1. *Hyperoxymuriate of Potash.* This salt crystallizes in flat rhomboidal prisms, of a silvery whiteness. Its taste is cooling, austere, and disagreeable, somewhat analogous to that of nitre. It dissolves in 16 parts of cold, and 2½ of boiling water. It is not sensibly altered by exposure to the air. When heated nearly to redness, it gives out more than a third of its weight of oxygen gas. It detonates loudly when mixed with sulphur or phosphorus, and struck upon an anvil, or triturated in a mortar. The experiment ought not to be tried with more than a grain of the mixture. It may be made into gunpowder with sulphur and charcoal, but it is liable to explode during the preparation.*

Sp. 2. *Hyperoxymuriate of Soda.* This salt is not easily obtained pure, because it is as soluble in water as the muriate of soda, with which it is mixed in the preparation. It crystallizes in cubes. It produces a sensation of cold in the mouth, and has a taste different from that of common salt. It dissolves in about three parts of cold water. In the air it deliquesces slightly. It dissolves in alcohol.

Sp. 3. *Hyperoxymuriate of Ammonia.* This salt may be formed by mixing carbonate of ammonia with an earthy hyperoxymuriate. It is very soluble in water and alcohol, and is decomposed at a moderate temperature.

Sp. 4. *Hyperoxymuriate of Magnesia.* This salt resembles the hyperoxymuriate of lime in its properties.

Sp. 5. *Hyperoxymuriate of Lime.* This salt may be formed by passing a current of oxymuriatic acid gas through lime diffused in water, and boiling phosphate of silver in the solution, filtering and evaporating. Its taste is sharp and bitter. It is very deliquescent, and dissolves copiously in alcohol.

Sp. 6. *Hyperoxymuriate of Barytes.* This salt may be obtained in the same way as the preceding species. It is soluble in four parts of cold water.

Sp. 7. *Hyperoxymuriate of Strontian.* This salt may be prepared like the preceding. It crystallizes in needles, deliquesces, and is soluble in alcohol.

The following Table exhibits a view of the constituents of the hyperoxymuriates, as far as has been ascertained.

Hyperoxymuriate of	Acid.	Base.	Water.
Magnesia	100	42.80	23.83
Soda	100	44.78	6.35
Lime	100	51.25	29.89
Strontian	100	56.52	60.87
Potash	100	67.24	4.30
Barytes	100	89.78	22.98

GENUS XII. *Arseniates.*

When the salts belonging to this genus are heated along with charcoal powder, they are decomposed, and arsenic sublimes.

Sp. 1. *Arseniate of Potash.* This salt does not crystallize. It deliquesces, and changes vegetable blues to green. The *superarseniate of potash* is a transparent white salt, which crystallizes in four-sided prisms, terminated by four-sided pyramids. It is soluble in water, and gives a red colour to vegetable blues.

Sp. 2. *Arseniate of Soda.* This salt crystallizes in six-sided prisms. The superarseniate does not crystallize.

Sp. 3. *Arseniate of Ammonia.* This salt crystallizes in rhomboidal prisms. With an excess of acid it crystallizes in needles.

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* This substance rubbed up with sugar, is capable of combustion by simply touching the mass with a drop of sulphuric acid.—On this fact is founded the formation of a new species of matches; a piece of card, dipped in sulphur, is covered at the extremity with this composition; and accompanied by a small phial containing the acid, affords a ready mode of procuring an instantaneous light. It is nearly twelve months since a number of these matches were given me by a gentleman on his arrival from England; and I made a number soon after perfectly similar.—A patent, I observe, has been taken out for these matches in the United States—with what propriety this statement will evince. COXE.

Sp. 4. *Arseniate of Magnesia.* This salt does not crystallize, but may be obtained in a solid gummy mass.

Sp. 5. *Arseniate of Lime.* This salt crystallizes, and is soluble in water.

Sp. 6. *Arseniate of Barytes.* This salt is insoluble in water, and cannot be crystallized.

Sp. 7. *Arseniate of Alumina.* This salt is a white powder, insoluble in water.

Sp. 8. *Arseniate of Yttria.* This salt is likewise a white powder, which does not crystallize.

Genus XIII. *Arsenites.*

The term *arsenite* has been applied to the combinations of white oxide of arsenic with the salifiable bases. The alkaline arsenites are yellow-coloured masses with a nauseous odour, not crystallizable, formerly called *livers of arsenic.* The earthy arsenites are white powders, nearly insoluble in water.

Genus XIV. *Molybdates.*

If into a solution of a molybdate a cylinder of tin with some muriatic acid be put, the liquid gradually assumes a deep blue colour.

Sp. 1. *Molybdate of Potash.* This salt crystallizes in small rhomboidal plates. It is bright, and has a metallic taste. It is soluble in hot water.

Sp. 2. *Molybdate of Soda.* This salt crystallizes, and is very soluble in water.

Sp. 3. *Molybdate of Ammonia.* This salt is soluble in water, and does not crystallize.

Sp. 4. *Molybdate of Magnesia.* This salt also is soluble in water, and does not crystallize.

Sp. 5. *Molybdate of Lime.* This is a white insoluble powder.

Genus XV. *Tungstates.*

These salts are combinations of yellow oxide of tungsten with the salifiable bases.

Sp. 1. *Tungstate of Potash.* This salt is soluble in water, deliquesces, and does not crystallize. Its taste is metallic and caustic.

Sp. 2. *Tungstate of Soda.* This salt crystallizes in elongated hexahedral plates. Taste acrid and caustic. Soluble in four parts of cold and two parts of boiling water.

Sp. 3. *Tungstate of Ammonia.* This salt crystallizes in needles or small plates. Its taste is metallic. It is soluble in water, and does not deliquesce.

Sp. 4. *Tungstate of Magnesia.* This salt crystallizes in small brilliant scales. It is soluble in water, and not altered by exposure to the air.

Sp. 5. *Tungstate of Lime.* This salt is found native. It is usually crystallized. The crystals are octahedrons. Colour yellowish grey, semi-transparent. It is insoluble in water, and not altered by exposure to the air.

Sp. 6 and 7. The tungstates of barytes and of alumina, are white insoluble powders scarcely examined.

Genus XVI. *Chromates.*

This genus of salts has been but imperfectly examined. The salts have usually a yellow colour. The alkaline chromates and chromate of lime are soluble in water, and crystallize. Chromate of barytes appears to be insoluble.

Genus XVII. *Columbates.*

This genus of salts has been very imperfectly examined. We know only the columbate of potash, which crystallizes in scales. Its taste is acrid and disagreeable.

ORDER II.

Combustible Salts.

Genus I. *Acetates.*

The acetates are all soluble in water. Heat decomposes them, driving off and destroying the acid. When mixed with sulphuric acid and distilled, acetic acid comes over, easily distinguished by its smell.

Sp. 1. *Acetate of Potash.* This salt is usually obtained in plates, but it crystallizes regularly in prisms. It has a sharp warm taste. It deliquesces in moist air, but in dry air undergoes but little alteration. It is soluble also in alcohol. When heated it melts, and in a high temperature is decomposed.

Sp. 2. *Acetate of Soda.* This salt crystallizes in striated prisms, not unlike those of sulphate of soda. It has a sharp taste, inclining to bitter. It dissolves in rather less than three times its weight of cold water. It is not affected by exposure to the air. When heated it loses its water of crystallization, and is decomposed.

Sp. 3. *Acetate of Ammonia.* This salt, called formerly *spirit of Mindererus*, cannot easily be crystallized by evaporation, but it may be obtained in needles by slow sublimation. Its taste is similar to that of a mixture of sugar and nitre. It is very deliquescent. It melts at 170°, and sublimes at about 250°.

Sp. 4. *Acetate of Magnesia.* This salt does not crystallize. It has a sweetish taste. It is very soluble both in water and alcohol. It deliquesces in the air.

Sp. 5. *Acetate of Lime.* This salt crystallizes in needles, and has a glossy appearance like satin. Its taste is bitter and acid. It is soluble in water, and not altered by exposure to the air.

Sp. 6. *Acetate of Barytes.* This salt crystallizes in fine transparent prismatic needles. Its taste is acid, and somewhat bitter. It dissolves in little more than its weight of water, and rather effloresces in the air. Alcohol dissolves about $\frac{1}{100}$ of its weight of it.

Sp. 7. *Acetate of Strontian.* This salt crystallizes. Its taste is not unpleasant. It dissolves in little more than its weight of cold water. It gives a green colour to vegetable blues.

Sp. 8. *Acetate of Alumina.* This salt crystallizes in needles, is very deliquescent, and has an astringent taste.

Sp. 9. *Acetate of Yttria.* This salt crystallizes in six-sided plates of an amethyst red colour, and is not altered by exposure to the air.

Sp. 10. *Acetate of Glucina.* This salt does not crystallize, but yields a gummy mass. Its taste is sweet and astringent.

Sp. 11. *Acetate of Zirconia.* This salt does not crystallize, but may be obtained in the state of a powder, which does not attract moisture from the air. Its taste is astringent. It is very soluble in water and in alcohol.

The following Table exhibits a view of the constituents of these salts, as far as they have been ascertained.

Acetates of	Acid.	Base.
Alumina	100	35.48
Magnesia	100	41.55
Ammonia	100	45.40
Lime	100	53.58
Soda	100	58.04
Strontian	100	89.80
Potash	100	108.45
Barytes	100	131.60

GENUS II. *Benzoates.*

This genus of salts has been so superficially examined, that a detailed description of the species cannot be given. All the benzoates examined are soluble in water, crystallize, and have a sharp saline taste. The benzoates of ammonia and alumina deliquesce, the others do not. Most of the species form feather-shaped crystals.

GENUS III. *Succinates.*

This genus of salts is almost as little known as the preceding. Most of the succinates crystallize. Succinate of magnesia is an exception; and succinates of barytes and glucina are nearly insoluble in water.

GENUS IV. *Moroxylates.*

Only two species of this genus have been examined, the moroxylates of lime and ammonia, both of which crystallize in needles, and are soluble in water.

GENUS V. *Camphorates.*

The salts belonging to this genus have usually a bitterish taste. When heated they are decomposed, and the acid commonly sublimes. Before the blow-pipe they burn with a blue flame.

Sp. 1. *Camphorate of Potash.* This salt is white and transparent, and crystallizes in hexagons. It dissolves in 100 parts of cold, and in four parts of hot water. Alcohol also dissolves it, and burns with a deep blue flame. When heated it melts, and the acid is volatilized.

Sp. 2. *Camphorate of Soda.* This salt is white and transparent. Its crystals are irregular. It dissolves in rather more than 100 parts of cold, and in eight parts of hot water. It is soluble in alcohol. It effloresces slightly in the air.

Sp. 3. *Camphorate of Ammonia.* This salt does not readily crystallize. It is opake, and has a sharp bitterish taste. It dissolves in about 100 parts of cold, and three parts of hot water. It is soluble in alcohol. When heated it sublimes.

Sp. 4. *Camphorate of Magnesia.* This salt does not crystallize. It is white, opake, and has a bitter taste. It requires about 290 parts of water to dissolve it. Cold alcohol does not act on it, hot alcohol decomposes it, and dissolves the acid.

Sp. 5. *Camphorate of Lime.* This salt does not crystallize. Cold water dissolves very little of it; hot water dissolves about $\frac{1}{200}$th part. It is insoluble in alcohol. In the air it falls to powder. When heated it melts, and the acid is volatilized.

Sp. 6. *Camphorate of Barytes.* This salt does not crystallize. It has little taste. It is scarcely soluble in water or alcohol. It is not altered by exposure to the air. When heated it melts, and the acid is volatilized.

Sp. 7. *Camphorate of Alumina.* This salt is a white powder, with an acid, bitter, astringent taste. It dissolves in about 200 parts of cold water, and in a much smaller quantity of hot water. Hot alcohol dissolves it readily.

GENUS VI. *Oxalates.*

The salts belonging to this genus are easily decomposed in a red heat; water, carbonic acid, carbonic oxide, carbureted hydrogen and charcoal are evolved, and the acid destroyed. The alkaline oxalates are soluble in water, and crystallize. They combine with an excess of acid, and form super-oxalates. The earthy oxalates are insoluble in water, or nearly so. Lime water occasions a precipitate in the solution of oxalates, provided there be no great excess of acid.

Sp. 1. *Oxalate of Potash.* This salt crystallizes in flat rhomboids. Its taste is cooling and bitter. It dissolves in thrice its weight of cold water. It absorbs a little moisture from the atmosphere.

Sp. 2. *Superoxalate of Potash.* This salt is extracted from sorrel, and usually sold under the name of the *essential salt of lemons.* Its crystals are small opake parallelopipeds. It has an acid, pungent, bitterish taste. It dissolves in about ten times its weight of boiling water, but requires a much greater quantity of cold water. It is not altered by exposure to the air. It contains exactly double the quantity of acid which the oxalate of potash contains.

Sp. 3. *Quadroxalate of Potash.* This salt was lately discovered by Dr Wollaston, by digesting superoxalate of potash in nitric or muriatic acids. One half of the alkali is separated, and there remains behind a salt, which may be obtained in crystals, and which contains four times the proportion of acid that exists in oxalate of potash.

Sp. 4. *Oxalate of Soda.* This salt crystallizes, and has nearly the same taste with the oxalate of potash. When heated it falls to powder, being deprived of its water of crystallization.

Sp. 5. *Oxalate of Ammonia.* This salt crystallizes in four-sided prisms, terminated by dihedral summits. Its taste is bitter and unpleasant, somewhat similar to that of sal-ammoniac. 100 parts of cold water dissolve 4½ of this salt. It is insoluble in alcohol. When distilled, carbonate of ammonia is disengaged, a little acid sublimed, and some charcoal left behind.

Sp. 6. *Oxalate of Alumina.* This salt does not crystallize, and has a yellow colour. It has a sweet astringent taste, is soluble in water, and sparingly soluble in alcohol. It deliquesces in the air.

The remaining species are nearly insoluble in water.

Sp. 7. *Oxalate of Magnesia.* This is a tasteless white powder, not sensibly soluble in water; yet oxalate of ammonia does not occasion a precipitate when dropt into sulphate of magnesia.

Sp. 8. *Oxalate of Lime.* This is a white powder, insoluble in water, which makes its appearance when oxalate of ammonia is poured into any neutral salt with base of lime. It is tasteless, and dissolves readily in acids.

Sp. 9. *Oxalate of Barytes.* This is an insoluble, tasteless, white powder. With an excess of acid, it may be obtained crystallized in needles.

Sp. 10. *Oxalate of Strontian.* This is a white, insoluble, tasteless powder.

Sp. 11. *Oxalate of Yttria.* This is also a white, insoluble, tasteless powder.

The following Table exhibits the composition of the oxalates, as far as ascertained:—

Oxalates of	Acid.	Base.
Ammonia	100	38.2
Magnesia	100	37.6
Soda	100	69.7
Lime	100	61.2
Potash	100	102.7
Strontian	100	119.5
Barytes	100	164.3

GENUS VII. *Mellates.*

This genus of salts has been but imperfectly examined. The alkaline mellates are soluble in water, and crystallize. The earthy do not appear soluble, and therefore are usually in the state of flaky powders.

GENUS VIII. *Tartrates.*

These salts, when exposed to a red heat, are decomposed, and the base remains in the state of a carbonate, usually mixed with charcoal. The earthy tartrates are nearly insoluble in water; the alkaline are soluble; but they combine with an excess of acid, and are converted into supertartrates, which are much less soluble than the tartrates. They readily combine with another base, and form triple salts.

Sp. 1. *Tartrate of Potash.* Of this salt there are two varieties. The first, containing an excess of acid, is usually called *tartar.* The second, which is neutral, is called *tartrate of potash*, and formerly it was called *soluble tartar*, from its greater solubility in water.

Variety 1. *Supertartrate of Potash*, or *Tartar.* This salt deposites itself on the sides of casks in which wine is kept. It is purified by solution and evaporations. It is from it that tartaric acid is usually obtained. Its crystals are small and irregular. Its taste is acid, and rather unpleasant. It is brittle, and soluble in about 60 parts of cold water. It is not altered by exposure to the air, but when kept dissolved in water is gradually decomposed. When distilled, it gives out a great deal of heavy inflammable air, and carbonic acid gas; and an acid liquor is obtained, formerly called *pyrotartarous acid*, but now known to be merely the acetic, contaminated with a little empyreumatic oil. The tartar of commerce contains about 5 per cent. of tartrate of lime.

Variety. 2. *Tartrate of Potash.* This salt may be formed by saturating the preceding with potash or its carbonate. Its crystals are flat four-sided rectangular prisms, terminated by dihedral summits. It dissolves in about its own weight of cold water. Its taste is an unpleasant bitter.

Sp. 2. *Tartrate of Soda.* This salt crystallizes in needles. It is soluble in its own weight of cold water. It is capable of forming a *supertartrate.*

Sp. 3. *Tartrate of Ammonia.* This salt crystallizes in small polygonal prisms. It has a cooling bitter taste. It is very soluble in water. It is said also to be capable of forming a *supertartrate.*

Sp. 4. *Tartrate of Potash and Soda.* This salt may be formed by saturating *tartar* with carbonate of soda. It was formerly called *Rochelle salt*, and *salt of Seignette.* It crystallizes in large irregular prisms. It has a bitter taste, is very soluble in water, and effloresces when exposed to the air.

Tartar forms also a triple salt when neutralized by ammonia.

Sp. 5. *Tartrate of Magnesia.* This salt is insoluble in water, unless it contains an excess of acid. In that case it crystallizes in six-sided prisms.

Tartar forms a triple salt when neutralized by magnesia.

Sp. 6. *Tartrate of Lime.* This salt is a white powder, insoluble in cold water. It is difficult to free it from water by heat. An excess of acid renders it soluble.

Tartar forms a triple salt when neutralized by lime.

Sp. 7. *Tartrate of Barytes.* This salt is soluble; but its properties have not been ascertained.

Sp. 8. *Tartrate of Strontian.* This salt crystallizes in triangular tables. It is insipid, and nearly insoluble in water.

Tartar forms triple salts when neutralized by barytes and strontian.

Sp. 9. *Tartrate of Alumina.* This salt does not crystallize, but forms a gummy mass soluble in water. Its taste is astringent. It does not deliquesce.

Tartar forms a triple salt when neutralized by alumina.

Sp. 10. *Tartrate of Yttria.* This salt is soluble in water, but not to a great degree.

The following Table exhibits the composition of the tartrates, as far as it has been ascertained.

Tartrates of	Acid.	Base.
Alumina	100	31.06
Magnesia	100	36.30
Ammonia	100	39.67
Lime	100	45.00
Soda	100	50.80
Strontian	100	78.60
Potash	100	72.41
Barytes	100	131.41

GENUS IX. *Citrates.*

When barytes is poured into a solution of a citrate, a precipitate appears. They are decomposed also by the mineral acids, and by oxalic and tartaric acids. When distilled, they yield traces of acetic acid. When kept dissolved in water, the acid is gradually decomposed.

Sp. 1. *Citrate of Potash.* This salt does not crystallize easily. It is very soluble in water, and readily deliquesces.

Sp. 2. *Citrate of Soda.* This salt crystallizes in six-sided prisms, not terminated by pyramids. Its taste is salt and cooling, but mild. It dissolves in less than twice its weight of water. When exposed to the air it effloresces slightly.

Sp. 3. *Citrate of Ammonia.* This salt crystallizes in elongated prisms. Its taste is cooling, and moderately saline. It is very soluble in water.

Sp. 4. *Citrate of Magnesia.* This salt is very soluble in water. It does not crystallize.

Sp. 5. *Citrate of Lime.* This is a white powder, scarcely soluble in water, but with an excess of acid it may be obtained in crystals.

Sp. 6. *Citrate of Barytes.* This salt is very imperfectly insoluble in water. It may be obtained in the state of a white powder, or of silky flakes.

Sp. 7. *Citrate of Strontian.* This salt is soluble in water. It may be obtained in crystals; and is said to resemble in its properties the oxalate or tartrate of strontian.

GENUS X. *Kinates.*

Only one species of this genus of salts has been hitherto examined, namely *kinate of lime*, obtained by macerating yellow Peruvian bark in water, and evaporating the solution. It is white, crystallizes in rhomboidal plates, dissolves in about five times its weight of cold water, and is insoluble in alcohol. When heated sufficiently, it is decomposed, and the acid destroyed.

GENUS XI. *Saccolates.*

These salts have hitherto been too superficially examined to admit of description. The alkaline saccolates are soluble in water, but the earthy are insoluble in that liquid.

GENUS XII. *Sebates.*

From the observations of Berzelius, it appears that the sebates approach very nearly to the benzoates in their properties.

GENUS XIII. *Urates.*

For the best account of these salts, we are indebted to Dr Henry. They are white powders destitute of taste, and imperfectly soluble in water. Urate of ammonia is the most soluble, and urate of barytes the least soluble.

GENUS XIV. *Malates.*

This genus of salts has also been imperfectly investigated. The alkaline malates are soluble in water, and deliquesce in the air. Malates of barytes and lime are nearly insoluble, but the latter combines with an excess of acid, and forms a supermalate of lime, which dissolves in water. This last salt is common in the vegetable kingdom. Malate of strontian dissolves in water, and malate of magnesia is very soluble in that liquid.

GENUS XV. *Formiates.*

These salts resemble the acetates in their properties, but they have been only superficially examined.

GENUS XVI. *Suberates.*

These salts have a bitter taste. They are all soluble in water, except the suberate of barytes. The earthy suberates scarcely crystallize. Most of these salts have an excess of acid.

GENUS XVII. *Gallates.*

The gallic acid seems scarcely capable of forming permanent salts with the salifiable bases. When the alkalies are dropt into a solution of gallic acid, it assumes a green colour. When the liquid is evaporated, the acid seems to be decomposed. Gallic acid occasions a blue or a red colour, when dropt into lime, barytes, or strontian water.

GENUS XVIII. *Prussiates.*

The prussic acid combines with the salifiable bases, but the compounds have little permanency, as the acid is separated by mere exposure to the air, or by a heat of 120°. Hence these salts have been but little examined. It is capable of combining with an alkali or earth, and with a metallic oxide at the same time, and of forming triple salts, which have a great deal of permanency. The oxide of iron is the metallic oxide usually present. Of all these salts, the most important is the *prussiate of potash-and-iron*, or the *triple prussiate of potash*, as it is in common use as a re-agent. It crystallizes in cubes or parallelopipeds. It has a yellow colour, and is semitransparent. It contains about one-fourth of its weight of oxide of iron. It has a bitter taste, and is insoluble in alcohol, though soluble enough in water.

SECT. II. *Of Metalline Salts.*

Acids combine only with the oxides of metals: they seem incapable of uniting with metals themselves. Now most metals form more than one oxide, and acids are usually capable of combining with two oxides at least of the same metal. The properties of the salt vary a good deal, according to the state of oxidizement of the oxide. Thus muriatic acid combined with the protoxide of mercury, forms a salt insoluble in water, and which acts merely as a cathartic when taken internally. The same acid, combined with the peroxide of mercury, forms a salt which is soluble in water, and constitutes one of the most virulent poisons known. To distinguish the state of oxidizement of the metal in these salts therefore is necessary. At present we shall satisfy ourselves with denoting those metalline salts that contain protoxides by the usual name; while to the names of those that contain a peroxide, the syllables *oxy* will be prefixed.* Thus *sul-*

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* This view of the subject will evince, how imperfect at present is our chemical nomenclature. We might with equal propriety prefix the term *oxy* to the different peroxyds, and call them oxy-oxyds. COXE.

phate of mercury is the compound of sulphuric acid and protoxide of mercury; *oxysulphate of mercury* is the compound of the same acid and peroxide of mercury. As there are twenty-seven metals, it is obvious that the genera of metalline salts are twenty-seven.

GENUS I. *Salts of Gold.*

The salts of gold are soluble in water, and the solution has a yellow colour. Triple prussiate of potash occasions a white precipitate in them, and the infusion of nutgalls gives them a green colour, and occasions a brown precipitate which is gold reduced. A plate of tin or muriate of tin occasions a purple precipitate. Sulphate of iron precipitates the gold in the metallic state.

Sp. 1. *Muriate of Gold.* This salt is easily obtained by dissolving gold in a mixture of one part nitric, and four parts muriatic acid. The solution takes place speedily, and with effervescence. It has a yellow colour, and when sufficiently concentrated, lets fall small yellow crystals of muriate of gold. They are four-sided prisms or truncated octahedrons, and exceedingly deliquescent. The taste of this salt is acerb, with a little bitterness. It tinges the skin of an indelible purple colour. It dissolves readily in alcohol, and seems more soluble in ether than in water. Almost all the metals throw down the gold from this salt, either in the metallic state or in that of a purple oxide. Hydrogen, phosphorus, and sulphurous acid, produce the same effect by depriving the gold of its oxygen.* Muriate of tin occasions a beautiful powder, called *purple of cassius*. It is employed as a paint, and to give a red colour to glass and porcelain. According to Proust, it is a compound of three parts of the oxide of tin, and one part of gold, in the metallic state. But it seems more likely that the gold is in the state of protoxide.

Sp. 2. *Nitrate of Gold.* Nitric acid, containing a considerable proportion of nitrous gas in solution, dissolves gold, especially if it be much divided, as is the case in gold leaf. The solution has an orange colour, and cannot be evaporated to dryness without decomposition.

The other salts of gold have not hitherto been examined.

GENUS II. *Salts of Platinum.*

The solution of these salts in water has a brown or yellowish brown colour. No precipitate is produced by prussiate of potash or infusion of nutgalls. Sal ammoniac occasions a copious yellow-coloured precipitate.

Sp. 1. *Nitrate of Platinum.* Nitric acid does not act upon platinum, but it dissolves its peroxide, and forms a salt not hitherto examined.

Sp. 2. *Muriate of Platinum.* This salt is obtained by dissolving platinum in aqua regia, and evaporating the solution, which is of a dark brown colour and opake. Small irregular crystals of muriate of platinum may be obtained, not more soluble in water than sulphate of lime. This salt has a disagreeable astringent metallic taste. Heat drives off the acid, and reduces the oxide to the metallic state.

The properties of the remaining species have been but imperfectly examined. Potash and ammonia are capable of combining with the salts of platinum, and forming compounds very little soluble in water. Hence a precipitate takes place when these alkalies are poured into solutions containing platinum.

GENUS III. *Salts of Silver.*

The nitric is the only acid which dissolves silver with facility, but they all combine with its oxides and form salts, most of which are but sparingly soluble in water. When the salts of silver are exposed to the action of the blow-pipe on charcoal, a globule of silver is obtained. Muriatic acid, or a muriate, occasions a white precipitate in their solutions, which becomes black when exposed to the light. The prussiates occasion a white precipitate, and the hydrosulphuret of potash a black precipitate, in these solutions.

Sp. 1. *Nitrate of Silver.* There are two species of this salt; the first, which has been long known, is an *oxynitrate;* the second, recently discovered by Proust, is a *nitrate*.

1. *Oxynitrate.* Nitric acid dissolves silver with facility, nitrous gas being emitted. The solution is colourless and transparent; very heavy and very caustic. It tinges the skin of an indelible black, and is often used as a cautery. When evaporated sufficiently, it deposites crystals of oxynitrate of silver. They are usually in thin plates, transparent, and have an intensely bitter and metallic taste. It does not deliquesce, but becomes brown in a strong light. When heated, it readily melts, and congeals, when cold, into a grey mass, crystallized in needles. In this state it is cast into small cylinders, and used under the name of *lunar caustic* by surgeons, to open ulcers, and destroy fungous excrescences. It detonates when heated with combustibles, or when struck with phosphorus upon an anvil, and the silver is reduced. A moderate heat disengages the acid, and reduces the silver to the metallic state. It is composed of about seventy peroxide of silver, and thirty nitric acid.

2. *Nitrate.* This salt may be formed by boiling powder of silver in a saturated solution of oxynitrate of silver. A pale yellow coloured liquid is obtained, which contains nitrate in solution. This salt is exceedingly soluble in water, and is not easily crystallized. When sufficiently evaporated, it congeals entirely into a solid mass. When exposed to the air, or mixed with nitric acid, it speedily absorbs oxygen, and is converted into oxynitrate.

Sp. 2. *Hyperoxymuriate of Silver.* This salt may be obtained by boiling phosphate of silver in hyperoxymuriate of alumina. It is soluble in two parts of warm water; as the solution cools it crystallizes in small rhomboids, opake and dull like nitrate of lead. It is soluble in alcohol. When exposed to a moderate heat, oxygen gas is given out and muriate of silver remains. When mixed with sulphur, and struck upon an anvil, it detonates with prodigious violence.

Sp. 3. *Sulphate of Silver.* This salt may be formed by boiling powder of silver in sulphuric acid. A white mass is obtained, soluble in diluted sulphuric acid, and yielding crystals by evaporation. The crystals are small prisms. They dissolve in about 87 parts of water. They dissolve also in nitric acid. They melt when heated, and are easily decomposed, the silver being reduced. It is composed of about 17.4 acid and 82.6 peroxide of silver.

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* Charcoal effects the same reduction of gold from its muriatic solution. COXE.

Sp. 4. *Sulphate of Silver.* This salt may be obtained by mixing sulphate of ammonia and nitrate of silver. It is a white powder, scarcely soluble in water, and having an acrid metallic taste. In the light it becomes brown. When heated it is decomposed, and the silver reduced.

Sp. 5. *Phosphate of Silver.* This is a white powder, insoluble in water, but soluble in nitric acid.

Sp. 6. *Carbonate of Silver.* This is a white insoluble powder, which becomes black when exposed to the light.

Sp. 7. *Fluate of Silver.* This is a white powder, insoluble in water.

Sp. 8. *Borate of Silver.* This likewise is a white insoluble powder.

Sp. 9. *Acetate of Silver.* This salt crystallizes in small prisms, easily soluble in water. When heated it swells, and yields a portion of ethereal liquor. The silver is reduced.

Sp. 10. *Benzoate of Silver.* This salt is soluble in water, and does not deliquesce.

Sp. 11. *Succinate of Silver.* This salt crystallizes in thin oblong radiated prisms.

Sp. 12. *Oxalate of Silver.* This is a white powder, scarcely soluble in water, insoluble in alcohol, but soluble in nitric acid.

Sp. 13. *Tartrate of Silver.* This salt is soluble in water.

Sp. 14. *Citrate of Silver.* This salt is insoluble in water. It is decomposed by nitric acid.

Sp. 15. *Saccolate of Silver.* A white insoluble powder.

Sp. 16. *Malate of Silver.* A white powder.

Sp. 17. *Arseniate of Silver.* An insoluble brown powder.

Sp. 18. *Chromate of Silver.* A beautiful crimson powder, which becomes purple when exposed to the light.

Sp. 19. *Molybdate of Silver.* A white flaky powder.

GENUS IV. *Salts of Mercury.*

Mercurial salts when strongly heated, are volatilized, and traces of mercury may sometimes be observed. The prussiates occasion in them a white precipitate; hydrosulphuret of potash, a black precipitate; and infusion of nutgalls, an orange yellow precipitate.

Sp. 1. *Nitrate of Mercury.* There are two species of this salt, first correctly distinguished by Bergman, namely, the *nitrate* and *oxynitrate*.

1. *Nitrate.* This salt is obtained by dissolving mercury in diluted nitric acid without the assistance of heat. The solution is colourless, very heavy, and caustic. It tinges the skin indelibly black. It crystallizes in transparent octahedrons, having their angles truncated. Sulphureted hydrogen gas passed through the solution of this salt, reduces the mercury, which separates in combination with sulphur. Muriate of tin throws down the base in the state of running mercury.*

2. *Oxynitrate.* This salt is formed when nitric acid is made to dissolve mercury with the assistance of heat, provided an excess of mercury be not present. By continuing the heat, the solution passes into a yellow coloured crystalline mass. When diluted with water, a white or yellow powder separates, which is a *suboxynitrate of mercury*.

Sp. 2. *Hyperoxymuriate of Mercury.* Mr Chenevix obtained this salt by passing a current of oxymuriatic acid through water, in which red oxyde of mercury was diffused. By evaporating the solution, crystals of *oxymuriate* and *hyperoxymuriate of mercury* were deposited. The latter were picked out and purified by a subsequent crystallization. This salt is soluble in about four parts of water.

Sp. 3. *Sulphated Mercury.* Of this salt there are two species, the *sulphate* and *oxysulphate*.

1. *Sulphate.* This salt may be obtained by boiling over mercury sulphuric acid, diluted with its own bulk of water. Very little sulphurous acid gas is disengaged. By evaporation the salt is obtained in small prismatic crystals. It dissolves in 500 parts of cold water, and is not altered by exposure to the air. The alkalies throw down a dark-coloured sub-sulphate of mercury, when poured into a solution of this salt. The sulphate of mercury is composed of 12 acid, 83 protoxide, and 5 water.

2. *Oxysulphate.* When three parts of sulphuric acid are boiled on two parts of mercury, the whole, by continuing the heat, is converted into *oxysulphate*. This salt crystallizes in small prisms. When neutral, its colour is a dirty white; but when in the state of *super-oxysulphate*, it is of a fine white. The neutral salt is not altered in the air, the super-oxysulphate deliquesces. It is composed of 31.8 acid, 63.8 peroxide, 4.4 water. When water is poured upon this salt, it is decomposed and converted into *super-oxysulphate*, which dissolves, and *suboxysulphate*, which remains in the state of a beautiful yellow powder. This sub-salt is used as a pigment, and was formerly known by the name of *turpeth mineral.* It is composed of 15 acid and 85 peroxide.†

Sp. 4. *Phosphate of Mercury.* This salt may be formed by mixing together the solutions of nitrate of mercury and phosphate of soda. It is a white powder, insoluble in water, lately introduced into medicine, and composed of 28.5 acid, 71.5 peroxide.

There seems to be no such salt as *phosphite of mercury.*

Sp. 5. *Carbonate of Mercury.* A white insoluble powder.

Sp. 6. *Fluate of Mercury.* A white insoluble powder.

Sp. 7. *Borate of Mercury.* A yellow insoluble powder.

Sp. 8. *Acetated Mercury.* Of this salt there are two species, the *acetate* and *oxacetate*.

1. *Acetate.* This salt may be obtained by mixing together solutions of nitrate of mercury and acetate of potash. Its crystals are plates of a silvery whiteness. It has an acrid taste, is insoluble in alcohol, and scarcely soluble in water.

2. *Oxacetate.* This salt may be formed by dissolving

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* This salt is employed in solution, to form calomel or mild muriat of mercury; by adding a solution of common salt to it, as Scheele has proposed; and with due attention, there is I think little danger of any admixture which can deteriorate the calomel. It is certainly a very preferable and far more easy method than the one usually pursued. COXE.

† By digesting sulphuric acid on red oxyd of mercury, a white mass is obtained, which, if washed in hot water, is changed to a beautiful yellow; as far as I have examined it, it appears to be a perfect Turpeth mineral. COXE.

red oxide of mercury in acetic acid. It is a yellow mass, which does not crystallize, and soon deliquesces in the air.

Sp. 9. *Succinate of Mercury.* This salt crystallizes, and is soluble in water.

Sp. 10. *Benzoate of Mercury.* A white powder, insoluble in water, and very sparingly soluble in alcohol.

Sp. 11. *Oxalate of Mercury.* A white powder, scarcely soluble in water, which blackens when exposed to the light. It detonates when heated.

Sp. 12. *Mellate of Mercury.* A white powder.

Sp. 13. *Tartrate of Mercury.* An insoluble white powder, becoming yellow when exposed to the air.

Sp. 14. *Citrate of Mercury.* A white mass, scarcely soluble in water.

Sp. 15. *Prussiate of Mercury.* This salt may be formed by boiling red oxide of mercury and prussian blue in water. It crystallizes in four-sided prisms, terminated by four-sided pyramids. Its taste is acrid and metallic. It is white, and soluble in water.

Sp. 16. *Arseniate of Mercury.* A yellow insoluble powder.

Sp. 17. *Molybdate of Mercury.* A white flaky powder.

Sp. 18. *Chromate of Mercury.* An insoluble powder, of a fine purple colour.

Genus V. *Salts of Palladium.*

The salts of this metal are almost all soluble in water, and the solution has a fine red colour. Prussiate of potash occasions a dirty yellowish brown precipitate; hydrosulphuret of potash, and the alkalies, an orange-yellow precipitate, when poured into solutions of these salts. Neither nitrate of potash nor sal ammoniac occasions any precipitate in them. Nitric, muriatic, and sulphuric acid, digested on palladium, acquire a red colour. But the true solvent of that metal is nitro-muriatic acid. The salts of palladium are not yet sufficiently known to admit of a particular description.

Genus VI. *Salts of Rhodium.*

The solutions of these salts are red. Prussiate of potash, hydrosulphuret of potash, sal ammoniac, and alkaline carbonates, occasion no precipitate in them. But the pure alkalies throw down a yellow powder, soluble in an excess of alkali.

Genus VII. *Salts of Iridium.*

These salts are soluble in water. The solution is at first green, but becomes red when concentrated in an open vessel. Neither prussiate of potash nor infusion of nutgalls occasion any precipitate, but they render the solutions of iridium colourless.

Genus VIII. *Salts of Osmium.*

This genus of salts is still entirely unknown.

Genus IX. *Salts of Copper.*

Most of these salts are soluble in water. The solution is blue or green, or at least it acquires these colours when exposed to the air. When ammonia is poured into these solutions, they assume a deep blue colour. Prussiate of potash occasions a greenish yellow precipitate, hydrosulphuret of potash a black precipitate, and gallic acid a brown precipitate in these solutions. A plate of iron or zinc put into these solutions, precipitates the copper in the metallic state.

Sp. 1. *Nitrate of Copper.* Nitric acid attacks copper with some violence, nitrous gas is emitted, and the metal dissolved. By evaporation, the salt crystallizes in parallelopipeds. It has a blue colour, its taste is acrid and metallic, and it is exceedingly caustic. It is very soluble in water, and speedily deliquesces in the air. When heated, it undergoes the watery fusion; and, if the heat be increased, the acid is driven off, and the black oxide of copper remains in a state of purity. It detonates feebly on burning coals. It detonates when mixed with phosphorus and struck upon an anvil. When moistened and wrapt up in tin-foil, it sets the tin on fire. It is composed of 16 acid, 67 oxide, and 17 water.

Sp. 2. *Hyperoxymuriate of Copper.* This salt may be formed by passing a current of oxymuriatic acid through water, containing oxide of copper diffused through it.

Sp. 3. *Muriated Copper.* Of this salt there are two species, the *muriate* and *oxymuriate*.

Sp. 4. *Sulphate of Copper.* This salt has been long known, and in commerce is distinguished by the names of *blue vitriol* or *blue copperas.* It crystallizes in oblique parallelopipeds, has a blue colour, a styptic metallic taste, and is employed as a caustic. It is soluble in about four parts of cold water. When exposed to the air, it effloresces very slightly. By heat it is decomposed, and black oxide of copper remains. It reddens vegetable blue, and is, in fact, a supersulphate. The real sulphate crystallizes in four-sided prisms, terminated by pyramids. This salt is composed of 49.1 acid, 50.9 oxide.

Sulphuric acid does not seem capable of combining with protoxide of copper.

Sp. 5. *Sulphite of Copper.* When sulphite of soda and sulphite of copper are mixed, whitish green crystals of sulphite of copper are deposited. They are sparingly soluble in water.

Sp. 6. *Phosphate of Copper.* A bluish green powder, insoluble in water.

Sp. 7. *Carbonate of Copper.* A beautiful apple green powder, insoluble in water. It is often found native, and is distinguished by mineralogists by the name of *malachite.*

Sp. 8. *Fluate of Copper.* This salt crystallizes in cubes of a blue colour.

Sp. 9. *Borate of Copper.* A green powder, scarcely soluble in water.

Sp. 10. *Acetate of Copper.* This salt was known to the ancients. It is sometimes called *verdigris;* though that name is more frequently applied to a *subacetate* of copper. It crystallizes in four-sided truncated pyramids. Its colour is a beautiful bluish green. Its taste is metallic and nauseous; and, like all the salts of copper, it is poisonous. It is sparingly soluble in cold water, but boiling water dissolves about one-third of its weight of it. It is soluble also in alcohol. When exposed to the air, it effloresces. When distilled, it yields acetic acid in considerable quantity. It is composed, according to Proust, of 61 acid and water, and 39 oxide of copper.

Sp. 11. *Succinate of Copper.* Small green crystals, not yet examined.

Sp. 12. *Benzoate of Copper.* Deep green crystals, sparingly soluble in water, and insoluble in alcohol.

Sp. 13. *Oxalate of Copper.* A green-coloured salt, scarcely soluble in water.

Sp. 14. *Tartrate of Copper.* Bluish green crystals, sparingly soluble in water.

Sp. 15. *Citrate of Copper.* Light green crystals.

Sp. 16. *Arseniate of Copper.* This salt is precipitated in the state of a bluish white powder, when arseniate of potash is poured into sulphate of copper. It is insoluble in water, unless it contains an excess of acid. It has been found native in Cornwall, in crystals, and has been analysed by Chenevix. There are five varieties of it, differing in the proportion of acid and oxide, in the figure of their crystals, and in colour.

The oxide of copper likewise combines with white oxide of arsenic, and forms a green powder, usually known by the name of *Scheele's green.*

Genus X. *Salts of Iron.*

Most of the salts of iron are soluble in water; the solution has a green, or yellowish, or reddish colour, according to the state of oxidizement of the iron. Prussiate of potash throws down from these solutions a blue powder, or at least it becomes blue when exposed to the air. Hydrosulphuret of potash occasions a black precipitate. Gallic acid and the infusion of nut-galls throws down a black or purple precipitate.

Sp. 1. *Nitrate of Iron.* Diluted nitric acid acts with great energy upon iron, a gas being extricated, which is a mixture of nitrous gas and nitrous oxide. There are two varieties of this salt.

1. *Nitrate.* This salt may be formed by dissolving iron in nitric acid of the specific gravity 1.16. The action is slow, and little gas is extricated. The iron is in the state of black oxide. The solution cannot be heated or concentrated without converting the iron into red oxide.

2. *Oxynitrate.* This salt may be formed by concentrating the preceding. The liquid assumes a red colour, and the red oxide of iron at last precipitates. The salt may be obtained in crystals, by keeping nitric acid in contact with black oxide of iron. The oxide gradually dissolves, and four-sided prisms, nearly colourless, are gradually formed. They deliquesce in the air.

Sp. 2. *Hyperoxymuriate of Iron.* This salt may be formed by passing a current of oxymuriatic acid through water, having red oxide of iron mixed with it.

Sp. 3. *Muriated Iron.* Of this salt there are two species, the *muriate* and *oxymuriate.*

1. *Muriate.* This salt may be formed by dissolving iron filings in muriatic acid, without the contact of the external air. The solution is green, and yields green-coloured crystals, very soluble in water. The solution absorbs nitrous gas in great abundance. When exposed to the air, it absorbs oxygen, and the salt is converted into oxymuriate.

2. *Oxymuriate.* This salt may be formed by exposing the preceding to the atmosphere, or by dissolving red oxide of iron in muriatic acid. The solution has a dark brown colour; the salt does not crystallize, but when evaporated to dryness, leaves a yellow-coloured mass, which deliquesces, and is soluble in alcohol. When heated, oxymuriatic acid is given out, and black oxide of iron remains still combined with muriatic acid.

Sp. 4. *Sulphated Iron.* Of this salt, likewise, there are two species, the *sulphate* and *oxysulphate.*

1. *Sulphate.* This salt was known to the ancients, and is used in considerable quantity in dyeing, and in the manufacture of ink. It is easily obtained by dissolving iron in diluted sulphuric acid, and evaporating the solution. It has a green colour, sometimes very light, sometimes very dark. In this last state it is preferred by artists. Upon what the difference depends is not accurately known. It crystallizes in rhomboidal prisms. It has a very styptic taste, and always reddens vegetable blues. It is soluble in two parts of cold, and in less than its weight of boiling water. It is insoluble in alcohol. When alkali is poured into a solution of this salt, a white powder precipitates, which is a *subsulphate of iron.* When heated, it melts, and loses its water of crystallization. In a red heat, it loses most of its acid, and is converted into a red powder, known by the name of *colcothar of vitriol,* and used in polishing glass and metallic bodies. This salt is composed of 26.7 acid, 28.3 base, and 45 water.

2. *Oxysulphate.* This salt may be formed by exposing the solution of the preceding to the open air. It has a yellowish red colour, does not crystallize, and when evaporated to dryness, soon attracts moisture, and becomes again liquid.

Sp. 5. *Sulphite of Iron.* Iron dissolves in sulphurous acid, without the emission of much gas. The solution yields crystals of sulphite, which are soon changed into sulphate by exposure to the air.

Sp. 6. *Phosphated Iron.* Of this salt there are two species, the *phosphate* and *oxyphosphate.*

1. *Phosphate.* This salt may be obtained by mixing solutions of phosphate of soda and sulphate of iron. It precipitates in the state of a blue powder. It is tasteless, insoluble in water, but soluble in nitric acid. It is found native, crystallized in blue coloured prisms.

2. *Oxyphosphate.* This is a white powder, insoluble in water, but soluble in acids, and precipitated by ammonia. When violently heated, it melts into an ash-coloured globule. When treated with a fixed alkali, it loses a portion of its acid, and is converted into a brown-coloured powder. In this state it is a *suboxyphosphate of iron.* It is insoluble in water, and nearly so in acids. But it dissolves in the serum of blood, and is supposed by some to give the red colour to blood.

Sp. 7. *Carbonate of Iron.* This salt may be obtained by precipitating sulphate of iron by an alkaline carbonate. It has been found native, crystallized in rhombs, somewhat transparent, of a greenish-yellow colour, and brittle. It is composed of 36 acid, 59.5 protoxide, and two water. *Rust* is frequently a carbonate of iron. Hence it effervesces when dissolved in acids.

Sp. 8. *Fluate of Iron.* Fluoric acid dissolves iron readily. The solution does not crystallize, but assumes the form of a jelly.

Sp. 9. *Borate of Iron.* A yellow powder, insoluble in water.

Sp. 10. *Acetated Iron.* Of this salt there are two species, the *acetate* and *oxacetate.*

1. *Acetate.* It may be obtained by dissolving sulphuret of iron in acetic acid. It forms green-coloured prismatic crystals, sufficiently soluble in water.

2. *Oxacetate.* A reddish-brown liquid, which does not crystallize, but is easily converted into a jelly, which deliquesces. This liquid is much used by calico-printers.

Sp. 11. *Succinate of Iron.* A brownish red powder, insoluble in water, unless there be an excess of acid present.

Sp. 12. *Benzoate of Iron.* Yellow crystals, with a sweet taste, soluble in water and in alcohol.

Sp. 13. *Oxalated Iron.* Oxalic acid attacks iron rapidly, and combines with both its oxides.

1. *Oxalate.* Prismatic crystals of a green colour, very soluble in water, with an excess of acid.

2. *Oxygenized Oxalate.* A yellow powder, scarcely soluble in water, and incapable of crystallizing.

Sp. 14. *Tartrated Iron.* The *tartrate* crystallizes, and is sparingly soluble in water; the *oxytartrate* is red, does not crystallize, but runs into a jelly.

Sp. 15. *Citrate of Iron.* A brown coloured solution, which deposites small crystals, very soluble in water.

Sp. 16. *Malate of Iron.* A brown solution which does not crystallize.

Sp. 17. *Gallate of Iron.* A deep blue or black powder, insoluble in water.

Sp. 18. *Prussiated Iron.* The *prussiate* is a white powder, the *oxyprussiate* a deep blue powder; both insoluble in water.

Sp. 19. *Arseniated iron.* The *arseniate* is a green-coloured salt, insoluble in water, found native, crystallizes in cubes. The *oxarseniate* is a brownish-red powder, likewise insoluble in water.

Sp. 20. *Tungstate of Iron.* An insoluble powder of a grey colour.

Sp. 21. *Molybdate of Iron.* An insoluble brown powder.

Sp. 22. *Columbate of Iron.* An insoluble mineral of a dark brownish-grey colour, and a lamellated structure.

GENUS XI. *Salts of Tin.*

Most of these salts are soluble in water, and the solution is colourless, or has a brownish colour, according to circumstances. The prussiates, when dropt into these solutions, occasion a white precipitate; hydrosulphuret of potash occasions a brownish black, or a golden yellow precipitate; corrosive sublimate occasions a black or a white precipitate; infusion of nut-galls occasions no precipitate in these solutions.

Sp. 1. *Nitrated Tin.* Nitric acid acts with great violence on tin, and speedily converts it into an oxide. When the acid is much diluted, it forms a yellow coloured solution, containing *deutoxide of tin.* But when the solution is left to itself, or when it is concentrated by evaporation, the oxide of tin is precipitated. When the acid is strong, it speedily converts the metal into peroxide without dissolving any of it. During the action ammonia is formed, and remains in combination with the acid.

Sp. 2. *Muriated Tin.* Muriatic acid dissolves tin when assisted by heat, and the salt formed is muriate of tin. By evaporation it is obtained in needle-shaped crystals, soluble in water, and somewhat deliquescent. It has a strong affinity for oxygen, and readily imbibes it from the atmosphere, from oxymuriatic and nitric acids, and from various metallic oxides and salts. Hence the remarkable changes which it produces on many metallic solutions.

Sp. 3. *Sulphate of Tin.* When tin is kept in sulphuric acid, little action takes place. However, the tin is gradually oxidized, and sulphurous acid gas is emitted. The sulphate of tin, formed, may be obtained in the state of fine needles by evaporation. It may be readily obtained by pouring sulphuric acid into muriate of tin; a white powder precipitates, which is the sulphate, and which dissolves in water and crystallizes.

The *Oxysulphate of tin* does not crystallize, but assumes the form of a jelly.

Sp. 4. *Sulphite of Tin.* When tin is kept in sulphurous acid, the acid is decomposed, oxide of tin dissolved, and sulphuret of tin precipitated.

Sp. 5. *Phosphate of Tin.* A white powder insoluble in water.

Sp. 6. *Carbonate of Tin.* As far as is known, this species of salt does not exist.

Sp. 7. *Fluate of Tin.* A gelatinous solution having a very disagreeable taste.

Sp. 8. *Borate of Tin.* A white powder insoluble in water.

Sp. 9. *Acetated Tin.* The *acetate* of tin crystallizes; the *oxacetate* forms a gummy incrystallizable mass.

Sp. 10. *Succinate of Tin.* This salt crystallizes, and is soluble in water.

Sp. 11. *Benzoate of Tin.* This salt is soluble in water, but insoluble in alcohol.

Sp. 12. *Oxalate of Tin.* Prismatic crystals, soluble in water.

Sp. 13. *Arseniate of Tin.* A white insoluble powder.

GENUS XII. *Salts of Lead.*

Many of these salts are scarcely soluble in water. Those that are, form colourless solutions, which have usually a sweet taste. The prussiates occasion a white precipitate in these solutions; hydrosulphuret of potash, a black precipitate; infusion of nutgalls, a white precipitate.

Sp. 1. *Nitrated Lead.* Of this salt there are two varieties; the first, composed of yellow oxide and nitric acid, has been long known; we shall call it *oxynitrate;* the second, or *nitrate*, has been lately discovered by Proust.

1. *Oxynitrate.* This salt is easily obtained by dissolving lead in diluted nitric acid, and evaporating the solution. The crystals are sometimes tetrahedrons, having their apexes truncated; sometimes octahedrons. They are opake and white, and have a silvery lustre. Their taste is sweet and harsh. They are not altered by exposure to the air. They dissolve in less than eight parts of boiling water. When heated, it decrepitates, and in a strong heat the acid is driven off, while at the same time the oxide is partially reduced to the metallic state. This salt is composed of 66 yellow oxide, 34 acid and water.

2. *Nitrate.* This salt is obtained by boiling lead in a solution of *oxynitrate.* A portion of the lead is dissolved, and the solution acquires a yellow colour. When evaporated, the salt crystallizes in scales, and in small prisms. The oxide in Dr Thomson's trials appeared to be the yellow; but Bucholz affirms that it contains less oxygen. This salt is composed of 81.5 oxide, 18.5 acid.

Sp. 2. *Hyperoxymuriate of Lead.* This salt is obtained by passing a current of oxymuriatic acid through water, in which oxide of lead is suspended. It is more soluble than muriate of lead, and is easily decomposed.

Sp. 3. *Sulphate of Lead.* This salt may be obtained by pouring sulphuric acid, or an alkaline sulphate, into nitrate of lead. It is a white powder, insoluble in water, in alcohol, and in nitric and acetic acids. It is found native, crystallized in octahedrons. It is composed of about 25 acid and 75 yellow oxide. A hundred parts of it, according to Kirwan, contain 71 of metallic lead. It may be heated to redness in a platinum crucible without alteration, but when in contact with charcoal, it melts, and the lead is reduced.

Sp. 4. *Sulphite of Lead.* This is a tasteless white powder, insoluble in water. It is composed of about 74.5 oxide, and 25.5 acid.

Sp. 5. *Phosphate of Lead.* A white tasteless powder insoluble in water, easily obtained by pouring phosphate of soda into nitrate of lead. It is found native, usually of a green or yellow colour, and is often crystallized in six-sided prisms. It is soluble in nitric and muriatic acids, and from the last solution muriate of lead precipitates. When heated, it melts, and assumes, on cooling, a regular polyhedral form. It is composed of 18 acid and 82 yellowish oxide.

Sp. 6. *Carbonate of Lead.* This is a white powder insoluble in water, easily obtained by mixing solutions of nitrate of lead, and an alkaline carbonate. It is found native, crystallized in six-sided prisms, and in tables. It is employed as a paint, under the name of *white lead.* It is composed of $16\frac{1}{3}$ acid, and $83\frac{2}{3}$ yellow oxide.

Sp. 7. *Fluate of Lead.* A white powder insoluble in water, unless there be an excess of acid.

Sp. 8. *Borate of Lead.* A white insoluble powder. Before the blowpipe it melts into a colourless glass.

Sp. 9. *Acetate of Lead.* Of this salt there are two varieties, the *superacetate* and *acetate.*

1. *Superacetate.* This salt has been long known. It is usually distinguished by the name of *sugar of lead.* It may be obtained by dissolving acetate of lead in acetic acid. It is much used by dyers and calico-printers. Its crystals are small needles, with a glossy appearance like satin. It has a sweet and rather astringent taste. Water dissolves rather more than $\frac{1}{4}$th of its weight of this salt. It is not altered by exposure to the air. When distilled, there comes over water acidulated with acetic acid, then a yellow inflammable liquor, which has some of the properties of ether. The gases extricated are carbonic acid in considerable quantity, with a very little heavy inflammable air. This salt is composed of 26 acid, 58 yellow oxide, 16 water.

2. *Acetate.* This salt may be obtained, by boiling together in water 100 parts of sugar of lead, and 150 parts of litharge. Its taste is less sweet; it is less soluble in water than the preceding variety; and it crystallizes in plates. A solution of this salt is employed by surgeons under the name of Goulard's extract.

Sp. 10. *Succinate of Lead.* Slender foliated crystals, scarcely soluble in water, but soluble in nitric acid.

Sp. 11. *Benzoate of Lead.* This salt forms white crystals, soluble in water and alcohol, and decomposed by heat.

Sp. 12. *Oxalate of Lead.* Small crystals insoluble in alcohol, and scarcely soluble in water, unless there be an excess of acid present.

Sp. 13. *Tartrate of Lead.* An insoluble white powder, decomposed by a moderate heat. It is composed of 37 acid, and 63 yellow oxide.

Sp. 14. *Citrate of Lead.* A white powder, difficultly soluble in water.

Sp. 15. *Malate of Lead.* A white powder, which precipitates in fine light flakes, and is insoluble in water, but easily soluble in acetic and weak nitric acid.

Sp. 16. *Arseniate of Lead.* A white powder, insoluble in water. It is composed of 35.7 acid, and 64.3 yellow oxide.

Sp. 17. *Molybdate of Lead.* A white powder, insoluble in water. It occurs native in rhomboidal plates, of a yellow colour, and is composed of 34.7 acid, and 65.3 yellow oxide.

Sp. 18. *Tungstate of Lead.* A white insoluble powder.

Sp. 19. *Chromate of Lead.* This is a fine red powder, with a shade of yellow, tasteless, and insoluble in water. It occurs native, crystallized in four-sided prisms, and is composed of 34.9 acid, and 65.1 oxide.

GENUS XIII. *Salts of Nickel.*

The salts belonging to this genus have been but imperfectly examined. They are generally soluble in water, and the solution has a fine green colour. Prussiate of potash dropt into them occasions a dull green precipitate, hydrosulphuret of potash a black precipitate, and the infusion of nutgalls a greyish white precipitate.

Sp. 1. *Nitrate of Nickel.* This salt crystallizes in eight-sided prisms; has a fine green colour; when exposed to the air it first deliquesces, and afterwards falls to powder, and gradually loses the whole of its acid. It is composed of 55 acid, 25 oxide, and 20 water. It dissolves in alcohol.

Sp. 2. *Muriate of Nickel.* This salt may be obtained by dissolving nickel in nitromuriatic acid, and evaporating the solution. It crystallizes irregularly, has an apple green colour, and deliquesces in the air. When heated it loses its water, and may be sublimed in the state of golden yellow flowers, which become green by absorbing water from the atmosphere. This salt is composed of 34 oxide, 11 acid, and 55 water. It is soluble in alcohol.

Sp. 3. *Sulphate of Nickel.* This salt has a fine green colour, and crystallizes in four-sided prisms, terminated by four-sided pyramids. It is soluble in three times its weight of water, and effloresces in the air. It is composed of 25.63 oxide, 29.37 acid, and 65 water.

Sp. 4. *Carbonate of Nickel.* This salt is obtained by precipitating nitrate of nickel with carbonate of potash. It is a green powder, composed of 56.4 acid and water, 43.6 oxide.

Sp. 5. *Fluate of Nickel.* A salt which yields light green-coloured crystals.

Sp. 6. *Acetate of Nickel.* A salt which forms rhomboidal crystals of a green colour. It dissolves in six times its weight of water.

Sp. 7. *Oxalate of Nickel.* A green powder, scarcely soluble in water.

Sp. 8. *Arseniate of Nickel.* A soluble salt of an apple green colour.

Sp. 9. *Molybdate of Nickel.* A white insoluble matter.

Sp. 10. *Phosphate of Nickel.* A green insoluble matter.

Sp. 11. *Borate of Nickel.* Similar to the preceding.

GENUS XIV. *Salts of Zinc.*

Most of the salts of zinc are soluble in acids, and may be formed directly by dissolving zinc in the different acids. Their solutions are transparent and colourless. Prussiate of potash occasions a white precipitate, and infusion of nutgalls no precipitate.

Sp. 1. *Nitrate of Zinc.* Nitric acid dissolves zinc with great rapidity. The solution yields flat four-sided prisms, which deliquesce in the air. They are very soluble both in water and alcohol. When heated they melt, and, in a strong heat, the acid is driven off, and the oxide remains

Sp. 2. *Muriate of Zinc.* Muriatic acid dissolves zinc with rapidity. The solution does not crystallize, but yields a gelatinous mass, which deliquesces in the air

When heated it sublimes, and forms a white-coloured mass composed of small needles. It is very soluble in water.

Sp. 3. *Sulphate of Zinc.* Diluted sulphuric acid dissolves zinc with rapidity. The solution, when concentrated, yields crystals of sulphate of zinc. This salt was discovered at Ramelsberg in Germany, about the middle of the 16th century, and introduced into commerce under the name of *white vitriol.* Its crystals are four-sided flat prisms. Cold water dissolves nearly 1½ times its weight of it, and boiling water dissolves any quantity whatever. When heated it melts, and, at a red heat, it parts with most of its acid. It is composed of 28.2 oxide, 25.8 acid, and 46 water. It contains an excess of acid.

Sp. 4. *Sulphite of Zinc.* Sulphurous acid dissolves zinc, and, by evaporation, two distinct sets of crystals are obtained. The first of *sulphureted sulphite*, consisting of sulphite combined with sulphur. Its crystals are four-sided prisms, soluble both in water and alcohol. In the air they become white, and deposite an insoluble powder. They absorb oxygen very slowly when exposed to the atmosphere. The *sulphite of zinc* also crystallizes. It is less acrid, but more styptic in its taste than sulphureted sulphite. It is less soluble in water, and insoluble in alcohol. When exposed to the air, it is speedily converted into sulphate.

Sp. 5. *Phosphate of Zinc.* This salt does not crystallize, but yields, when evaporated, a mass like gum arabic.

Sp. 6. *Carbozate of Zinc.* This salt may be obtained, by precipitating sulphate of zinc by an alkaline carbonate. It occurs native, and is known by the name of calamine. It is composed of one part acid, and two parts oxide.

Sp. 7. *Fluate of Zinc.* This salt is soluble in water, and does not crystallize.

Sp. 8. *Borate of Zinc.* A white powder insoluble in water.

Sp. 9. *Acetate of Zinc.*[*] Acetic acid readily dissolves zinc. The salt crystallizes in rhomboidal or hexagonal plates of a talcky appearance. Its taste is bitter and metallic. It is soluble in water, and not altered by exposure to the air. On live coals it burns with a blue flame.

Sp. 10. *Succinate of Zinc.* Foliated crystals scarcely examined.

Sp. 11. *Benzoate of Zinc.* Needle-shaped crystals soluble in water and alcohol.

Sp. 12. *Oxalate of Zinc.* A white powder scarcely soluble in water.

Sp. 13. *Citrate of Zinc.* Small brilliant crystals insoluble in water.

Sp. 14. *Arseniate of Zinc.* A white powder insoluble in water.

The tungstate, molybdate, and chromate of zinc, are also insoluble in water. The first two are white, the last orange red.

GENUS XV. *Salts of Bismuth.*

This genus of salts has been but imperfectly examined. The solutions of them are usually colourless, and when water is added to them, a white powder precipitates, unless there be a considerable excess of acid present. Prussiate of potash occasions a white precipitate, hydrosulphuret of potash a black precipitate, and infusion of nutgalls an orange precipitate, when poured into these solutions.

Sp. 1. *Nitrate of Bismuth.* Nitric acid attacks bismuth with great violence. The solution is colourless, and deposites small white crystals, which are four-sided prisms. They attract a little moisture in the air. They detonate feebly on burning coals, loudly when triturated with phosphorus. When dissolved in water they are decomposed, and a white powder, which is a subnitrate of bismuth, is deposited.

Sp. 2. *Muriate of Bismuth.* This salt may be obtained by dissolving bismuth in nitromuriatic acid, and evaporating to dryness. It forms small prismatic crystals. It sublimes when heated, and forms a white mass, which easily melts, formerly called *butter of bismuth.*

Sp. 3. *Sulphate of Bismuth.* This salt may be obtained by heating a mixture of bismuth and sulphuric acid. A white mass remains, decomposed by water.

Sp. 4. *Sulphate of Bismuth.* A white powder, insoluble in water.

Sp. 5. *Phosphate of Bismuth.* Crystals soluble in water, and not altered by exposure to the air. The *subphosphate of bismuth* is a white insoluble powder.

Sp. 6. *Acetate of Bismuth.* It may be obtained by mixing solutions of nitrate of bismuth and acetate of potash, and heating the mixture. Small talcky crystal of acetate of bismuth gradually precipitate.

Sp. 7. *Succinate of Bismuth.* Yellow crystalline plates, soluble in water.

Sp. 8. *Benzoate of Bismuth.* Needle-shaped crystals, not altered by exposure to the air, soluble in water, and very sparingly soluble in alcohol.

Sp. 9. *Oxalate of Bismuth.* A white powder, scarcely soluble in water.

Sp. 10. *Tartrate of Bismuth.* A white insoluble powder.

Sp. 11. *Arseniate of Bismuth.* A white tasteless powder, sometimes having a shade of green; insoluble in water and nitric acid, but soluble in muriatic acid.

Sp. 12. *Molybdate of Bismuth.* A white insoluble powder.

GENUS XVI. *Salts of Antimony.*

The oxides of antimony combine but imperfectly with acids, and the salts which they form have not been very carefully examined. Their solutions have usually a brownish yellow colour, and in most cases a precipitate falls when they are diluted with water. Prussiate of potash and infusion of nutgalls throw down a white precipitate, hydrosulphuret of potash an orange-coloured precipitate.

Sp. 1. *Nitrate of Antimony.* Nitric acid attacks antimony slowly. Nitrous gas is emitted, ammonia formed, and the metal converted into white oxide. A portion of it is dissolved, but it does not yield crystals.

Sp. 2. *Sulphate of Antimony.* Sulphuric acid oxidizes antimony at a boiling heat, and converts it into a white mass, from which water separates the acid.

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[*] This salt is more readily procured for medical purposes by adding acetat of lead to sulphat of zinc. The acetat of zinc remains in solution, and may be crystallized; the insoluble sulphat of lead is precipitated.

COXE.

Sp. 3. *Sulphite of Antimony.* This compound is precipitated in the state of a white powder, by pouring sulphurous acid into the solution of antimony in muriatic acid. It has an acrid and astringent taste, melts when heated, and is decomposed.

Sp. 4. *Phosphate of Antimony.* This salt is soluble in water: it does not crystallize.

Sp. 5. *Acetate of Antimony.* Acetic acid dissolves the oxides of antimony, and forms a salt which crystallizes, and is soluble in water.

Sp. 6. *Oxalate of Antimony.* Small crystalline grains, scarcely soluble in water.

Sp. 7. *Tartrate of Antimony.* This salt does not crystallize, but readily assumes the form of a jelly.

Sp. 8. *Arseniate of Antimony.* A white powder, insoluble in water.

Sp. 9. *Tartrate of Potash-and-Antimony.* This salt, usually called *tartar emetic*, was first made known to chemists in 1631. It may be prepared by mixing together equal parts of peroxide of antimony and tartar, and boiling them in ten times their weight of water, filtering the solution and evaporating it till a pellicle forms on the surface. It deposites regular crystals of tartar emetic. This salt is white, crystallizes in regular tetrahedrons, and gradually effloresces when exposed to the air. It dissolves in about 14½ parts of cold water, and in about two parts of boiling water. Heat decomposes it by destroying the acid. It is composed of 35.4 tartaric acid, 39.6 peroxide of antimony, 16.7 potash, and 8.3 water.

GENUS XVII. *Salts of Tellurium.*

Tellurium is too scarce a metal to expect that its salts should be completely examined. The fixed alkalies throw down, from their solutions, a white powder, which is re-dissolved by an excess of alkali. Prussiate of potash occasions no precipitate, hydrosulphuret of potash throws down a brown or blackish precipitate, and infusion of nutgalls a flaky yellow precipitate.

Sp. 1. *Nitrate of Tellurium.* Nitric acid readily dissolves tellurium. The solution is colourless, and not rendered turbid by water. When concentrated, it yields small crystals in needles.

Sp. 2. *Muriate of Tellurium.* Nitro-muriatic acid dissolves tellurium. Water throws down a white precipitate from the solution, which is re-dissolved by adding more water.

Sp. 3. *Sulphate of Tellurium.* Sulphuric acid dissolves tellurium. Water precipitates a white powder from the solution.

GENUS XVIII. *Salts of Arsenic.*

Arsenic is readily converted into an acid, and even its white oxide has acid properties. Hence it does not form permanent salts with acids. The acids, however, dissolve it. Prussiate of potash occasions a white precipitate in these solutions, and hydrosulphuret of potash a yellow precipitate, while the infusion of nutgalls produces no change.

Sp. 1. *Nitrate of Arsenic.* Nitric acid dissolves arsenic with violence, and separates a white powder scarcely soluble in water.

Sp. 2. *Muriate of Arsenic.* Muriatic acid dissolves arsenic when assisted by heat. It dissolves also the white oxide, especially if a little nitric acid be added. The muriate of arsenic may be obtained in small crystalline grains.

Sp. 3. *Sulphate of Arsenic.* Sulphuric acid oxidizes arsenic by the assistance of heat; the sulphate is a white powder very imperfectly soluble in water.

Sp. 4. *Acetate of Arsenic.* Acetic acid dissolves the white oxide of arsenic, and deposites crystals scarcely soluble in water.

GENUS XIX. *Salts of Cobalt.*

Most of these salts are soluble in water, and the solutions have a red colour, unless a great excess of acid be present. Alkalies precipitate a blue powder; prussiate of potash throws down a brownish yellow precipitate; hydrosulphuret of potash, a black precipitate; infusion of nutgalls, a yellowish white precipitate.

Sp. 1. *Nitrate of Cobalt.* Nitric acid dissolves cobalt when assisted by heat, and yields red prismatic crystals, which deliquesce in the air.

Sp. 2. *Muriate of Cobalt.* Muriatic acid dissolves cobalt when assisted by the presence of a little nitric acid. The solution is green, or, if there be no excess of acid, blue, but it becomes red when diluted with water. This solution forms the oldest and best known *sympathetic ink*. It is very much diluted with water. Characters drawn with it on paper in that state are colourless when cold, but acquire a fine green colour when heated. When the muriate is heated, it sublimes in grey coloured flowers, which dissolves with great difficulty in water. The solution consists of common muriate of cobalt.

Sp. 3. *Sulphate of Cobalt.* Sulphuric acid dissolves the peroxide of cobalt with difficulty. The solution is red, and yields needle-form crystals, consisting of rhomboidal prisms, terminated by dihedral summits. It is soluble in 24 parts of cold water, insoluble in alcohol, and not altered by exposure to the air. It is composed of 26 acid, 30 oxide, 44 water.

This salt readily combines with potash and ammonia, and forms triple salts with each.

GENUS XX. *Salts of Manganese.*

These salts are mostly soluble in water. Alkalies throw down from them a red or white precipitate, which becomes black when exposed to the air. Prussiate of potash occasions a yellowish white precipitate, hydrosulphuret of potash a white precipitate, gallic acid produces no change.

Sp. 1. *Nitrate of Manganese.* Nitric acid dissolves the black oxide of Manganese with the assistance of heat, provided a little sugar be added. The solution is colourless, and does not yield crystals.

Sp. 2. *Muriate of Manganese.* Muriatic acid readily dissolves black oxide of manganese when assisted by heat, abundance of oxymuriatic acid separating. The solution is colourless, and deposits small crystals of *muriate of manganese.* These crystals are not easily formed. When obtained, they are hard, very soluble in water, and deliquesce in the air. Muriatic acid appears also to combine with red oxide of manganese, and to form a red solution containing oxymuriate of manganese.

Sp. 3. *Sulphated Manganese.* Sulphuric acid readily dissolves the white and red oxides of manganese. Upon the black it has no action, unless it be assisted by heat. In that case, oxygen gas is emitted in abundance, and the oxide is dissolved, being converted into red or white oxide, according to circumstances. There are two combinations of sulphuric acid and the oxides of manganese; one with the *white*, and another with the *red* oxide.

1. *Sulphate.* The solution of this salt is colourless, and yields, by evaporation, rhomboidal crystals. They have a very bitter taste, and are decomposed by heat, which drives off the acid.

2. *Oxysulphate.* The solution of this salt has a red colour. It does not readily crystallize, but when evaporated, easily passes into a jelly. When evaporated to dryness, it yields red coloured saline crusts, very soluble in water, and not altered by exposure to the air.

GENUS XXI. *Salts of Chromium.*

The salts of chromium are but very little known. For the few facts ascertained, we are indebted to Richter, Godon, and Vauquelin. Prussiate of potash occasions a brown solution in these salts; infusion of nutgalls, a brown precipitate; hydrosulphuret of potash, a green precipitate, which a few drops of nitric acid change to yellow.

When the oxide of chromium is obtained by precipitating chromate of potash by means of a hydrosulphuret, it dissolves readily in acids. The solutions have a green colour, and the compounds are easily decomposed. Nitric acid seems to convert the oxide into chromic acid. It does not appear that these solutions are capable of affording crystals. The acids hitherto tried, and found capable of dissolving oxide of chromium, are the nitric, muriatic, sulphuric, phosphoric, sulphurous, and oxalic.

GENUS XXII. *Salts of Molybdenum.*

The salts belonging to this genus are as imperfect as those belonging to the preceding. None of them seem capable of crystallizing. But many acids dissolve oxide of molybdenum, and the solutions are remarkable for the changes of colour to which they are liable.

Nitric acid dissolves molybdenum with difficulty. If the quantity of metal be greater than the acid can dissolve, the solution is blue; but when a small quantity of molybdenum is dissolved in a considerable proportion of acid, the solution is yellowish brown.

Muriatic acid does not attack molybdenum, but it dissolves its oxide, and forms a blue coloured solution.

Sulphuric acid dissolves molybdenum when assisted by heat, and forms a yellowish brown or a blue solution, according to the proportion of metal acted on.

GENUS XXIII. *Salts of Uranium.*

Most of these salts are soluble in water, and the solution has a yellow colour. The pure alkalies occasion in these a yellow precipitate, prussiate of potash a brownish red precipitate, hydrosulphuret of potash a brownish yellow precipitate, and infusion of nutgalls a chocolate coloured precipitate.

Sp. 1. *Nitrate of Uranium.* Nitric acid readily dissolves uranium and its oxides. The solution, when sufficiently concentrated, yields crystals of nitrate, either in hexagonal tables, or in four-sided flat prisms, with a lemon yellow colour, and greenish edges. Water dissolves more than twice its weight of this salt, and alcohol more than thrice its weight of it. These liquids, when hot, dissolve any quantity of the salt whatever. Sulphuric ether dissolves about one-fourth its weight of this salt. Nitrate of uranium deliquesces in a moist atmosphere, but when kept at the temperature of 100° it soon falls to powder. When heated it melts, and, by continuing the heat, is decomposed. This salt is composed of 61 oxide, 25 acid, and 14 water.

By exposing the nitrate to a moderate heat, it is converted into a lemon-yellow powder, insoluble in water, which is a *sub-nitrate* of uranium.

Sp. 2. *Muriate of Uranium.* Deliquescent crystals of a yellowish green colour, having the form of four-sided tables.

Sp. 3. *Sulphate of Uranium.* Sulphuric acid scarcely acts upon uranium, but it gradually dissolves its oxide, and the solution yields small crystals of a lemon-yellow colour, in prisms or tables. This salt dissolves in less than its weight of cold water, and in about half its weight of boiling water. Alcohol dissolves $\frac{1}{25}$th of its weight of it. Heat decomposes it, driving off the acid and water, but a violent temperature is necessary. This salt is composed of

Acid	18
Oxide	70
Water	12
	100

Sp. 4. *Acetate of Uranium.* Acetic acid dissolves oxide of uranium, and yields beautiful crystals, in the form of long slender transparent four-sided prisms, terminated by four-sided pyramids.

GENUS XXIV. *Salts of Tungsten.*

This genus of salts is still unknown. None of them, from the difficulty of obtaining the metal in a state of purity, having been hitherto examined.

GENUS XXV. *Salts of Titanium.*

The salts of titanium, are, in general, soluble in water, and the solution is colourless. The alkaline carbonates occasion a flaky precipitate in these solutions, prussiate of potash a yellowish brown precipitate, hydrosulphuret of potash a dirty bottle-green, and the infusion of nutgalls a very bulky blood-red precipitate. When a rod of tin is plunged into a solution of titanium, the liquid around it gradually assumes a fine red colour. A rod of zinc occasions a deep blue colour.

Sp. 1. *Nitrate of Titanium.* Nitric acid dissolves the carbonate of titanium, and yields transparent crystals, in the form of elongated rhombs, having two opposite angles truncated, so as to represent six-sided tables.

Sp. 2. *Muriate of Titanium.* Muriatic acid dissolves the carbonate of titanium, and forms transparent cubic crystals. From the experiments of Vauquelin and Hecht, it appears that it is the peroxide of titanium only that combines with muriatic acid.

Sp. 3. *Sulphate of Titanium.* Sulphuric acid dissolves the carbonate of titanium. The solution does not crystallize, but yields, when evaporated, a white opake gelatinous mass.

GENUS XXVI. *Salts of Columbium.*

This genus of salts has been but imperfectly examined. Hatchett, Ekeberg, and Wollaston, are the only persons who have hitherto made experiments on this scarce metal. Sulphuric, nitric, and muriatic acids scarcely dissolve the oxide of columbium. The oxalic, tartaric, and citric acids dissolve it readily. The solutions appear to be transparent and colourless. Neither prussiate of potash, nor hydrosulphuret of potash, occasion any precipitate in these solutions; but infusion of nutgalls throws down an orange-coloured precipitate, provided there be no excess of acid present, but a slight excess of acid prevents the precipitate from appearing.

Genus XXVII. *Salts of Cerium.*

The salts of cerium have either a white or a yellow colour, according to the state of oxidizement of the metal. Their solutions in water have a sweet taste. Hydrosulphuret of potash throws down a white precipitate, prussiate of potash a milk-white precipitate, and infusion of nutgalls no precipitate whatever. The oxalate of ammonia occasions a white precipitate, which is insoluble in nitric and muriatic acids.

Sp. 1. *Nitrate of Cerium.* Nitric acid dissolves white oxide of cerium readily: the solution is colourless, crystallizes with difficulty, retains an excess of acid, and has an austere and sweet taste. It dissolves the red oxide with difficulty, unless heat be applied. The solution is yellow, and yields small white crystals, which deliquesce when exposed to the air. Both of these salts are soluble in alcohol. Heat decomposes them, leaving a red coloured oxide.

Sp. 2. *Muriate of Cerium.* Muriatic acid dissolves red oxide of cerium when assisted by heat, oxymuriatic gas is exhaled, and the solution has a yellowish red colour, which becomes lighter the longer the heat is continued. The solution yields four-sided prismatic crystals, of a yellowish white colour. They are soluble in alcohol, and deliquesce when exposed to the air. Their taste is astringent and sweet. Heat decomposes this salt by driving off the acid and water.

Sp. 3. *Sulphate of Cerium.* Sulphuric acid dissolves the red oxide of cerium by long digestion, an orange-coloured solution is obtained, which yields small octahedral and needle-form crystals. The colour of these crystals is partly lemon-yellow, partly orange. They are scarcely soluble in water. Their taste is acid and sweet. When exposed to the air, they soon fall into a yellow powder.

Sulphuric acid dissolves the white oxide of cerium very readily. The solution is colourless, has a sweet taste, and yields crystals of sulphate of cerium.

Sp. 4. *Carbonate of Cerium.* When white oxide of cerium is precipitated from its solutions by an alkaline carbonate, carbonate of cerium is obtained. It is a granular powder, of a silvery whiteness, insoluble in water, and composed of 23 acid, 65 oxide, and 12 water.

Sp. 5. *Acetate of Cerium.* Acetic acid dissolves the white oxide of cerium, and forms small sweet-tasted crystals, soluble in water, but very sparingly soluble in alcohol.

Chap. IV.

Of Hydrosulphurets.

Sulphureted hydrogen gas possesses many of the properties of an acid, and, like acids, it combines with the salifiable bases, and forms a class of bodies called *hydrosulphurets.* These bodies are of considerable importance, as they are frequently employed in chemical analysis, and enable us to separate the metallic oxides from alkalies and earths, because they throw down almost the whole of them from their solutions in an insoluble state.

The hydrosulphurets are soluble in water, and the solution is colourless. When the solution is exposed to the air, it becomes green or greenish yellow. After long exposure to the air, the solution becomes again limpid and colourless, and, on examination, is found only to contain the base of hydrosulphuret combined with sulphuric acid. The solution of the hydrosulphurets precipitates almost all the metallic oxides from their solutions; iron and lead, black; antimony, orange; arsenic, yellow, &c.

The hydrosulphurets may be formed, by dissolving or diffusing the respective bases in water, and passing a current of sulphureted hydrogen gas through the liquid till it ceases to absorb any more. The excess of gas is then driven off by heat; and the hydrosulphuret may be obtained in a solid state, if required, by evaporation. The yellow colour which these solutions acquire when exposed to the air, is owing to the decomposition of the sulphureted hydrogen by the gradual absorption of oxygen from the atmosphere.

Sp. 1. *Hydrosulphuret of Barytes.* When sulphate of barytes is converted into sulphuret by mixing it with charcoal, and heating it red hot in a crucible, if boiling water be poured upon the black mass, and filtered while hot, the green coloured solution thus obtained yields, by evaporation, a great number of crystals. These crystals are hydrosulphuret of barytes. They are white, and have a silky lustre. They have the form of scales, and the shape cannot easily be distinguished. This substance is soluble in water, the solution has a slight tint of green, its taste is acrid and sulphureous, and when exposed to the air is readily decomposed.

Sp. 2. *Hydrosulphuret of Strontian.* It may be procured by the same process as the preceding hydrosulphuret, and its properties are nearly similar.

Sp. 3. *Hydrosulphuret of Potash.* This substance is formed during the solution of sulphuret of potash, and may be obtained by evaporation. It is transparent and colourless, and crystallizes in large prisms, not unlike the figure of sulphate of soda. Its taste is alkaline, and extremely bitter. When exposed to the air, it soon deliquesces into a liquor of a syrupy consistence, tinging green all bodies with which it happens to come in contact. The crystals have no smell at first, but when they have deliquesced they emit a fetid odour. They dissolve both in water and alcohol, and during the evolution the temperature sinks considerably. Acids drive off the sulphureted hydrogen with a violent effervescence.

Sp. 4. *Hydrosulphuret of Soda.* The crystals of this substance are transparent and colourless, having the figure of four-sided prisms terminated by quadrangular pyramids. Its taste is alkaline, and intensely bitter. It is very soluble both in water and alcohol, and during the solution cold is produced. When exposed to the air it deliquesces, and acquires a green colour. Acids drive off the sulphureted hydrogen.

Sp. 5. *Hydrosulphuret of Lime.* This substance may be formed, by passing sulphureted hydrogen gas through water, having lime suspended in it. The solution is colourless, and has an acrid and bitter taste.

Sp. 6. *Hydrosulphuret of Ammonia.* This compound may be formed by passing sulphureted hydrogen through liquid ammonia. When equal parts of lime, sal ammoniac, and sulphur, mixed with a little water, are distilled in a retort, a yellow liquid is obtained, usually distinguished by the name of *fuming liquor of Boyle*, because first prepared by that philosopher. This liquid is little else than hydrosulphuret of ammonia holding an excess of ammonia in solution.

Sp. 7. *Hydrosulphuret of Magnesia.* This substance may be formed, by passing a current of sulphureted hydrogen through water in which magnesia is diffused. Its properties have not been hitherto examined.

Sp. 8 and 9. *Hydrosulphurets of Glucina* and of *Yttria.* From the experiments of Klaproth and Vauquelin, we know that the hydrosulphurets do not precipitate glucina or yttria from acids. Hence it is likely that they are capable of combining with sulphureted hydrogen, though these combinations have not hitherto been examined by chemists.

Neither alumina nor zirconia combine with sulphureted hydrogen. Hence the hydrosulphurets precipitate these earths from acids.

When the alkalies and alkaline earths are mixed with sulphur and water, and boiled in a glass vessel, a brown coloured solution is obtained, formerly called *liquid liver of sulphur*. At present the term *hydrogureted sulphurets* is applied to these solutions. They are conceived to be combinations of the alkaline bases with sulphur and sulphureted hydrogen at once, and therefore to be triple compounds. The proportion of sulphureted hydrogen is often very small.

The hydrosulphurets precipitate almost all the metals from their solutions. The precipitates vary in their colour according to the metal. The following Table exhibits a view of the colours of the various precipitates in these cases, as far as the subject has been investigated.

METALS.	PRECIPITATED BY Hydrosulphuret of Potash.	Hydrogureted Sulphuret of Potash.
Gold	Black	Black
Platinum	Black	Black
Silver	Black	Black
Mercury	Brown black	Brown, becoming black
Palladium	Black	
Copper	Black	Brown
Iron	Black	Black, becoming yellow
Nickel	Black	Black
Tin	Black	Black
Lead	Black	White, becoming black
Zinc	White	White
Bismuth	Black	Black
Antimony	Orange	Orange yellow
Tellurium	Black?	Deep brown or black
Arsenic	Yellow	Yellow
Cobalt	Black	Black
Manganese	White	White
Chromium	Green	
Molybdenum	Reddish brown	
Uranium	Brown	Brownish yellow
Titanium	Bottle-green	Bluish green.
Columbium	Chocolate	
Cerium	Brown	

CHAP. V.

Of Soaps.

The fixed oils have the property of combining with alkalies, earths, and metallic oxides, and of forming a class of compounds which have received the name of SOAPS. As these soaps differ from each other very materially, according as their base is an alkali, an earth, or a metallic oxide, it will be proper to consider each set separately.

SECT. I. *Of Alkaline Soaps.*

All or most of the fixed oils are capable of combining with the alkalies, and forming soap; but the differences which they produce on the qualities of the soap have only been observed in a few cases. We can only consider the different species occasioned by different alkalies.

Sp. 1. *Soap of Soda*, or *Hard Soap.* The word *soap* (*sapo*, σαπὼν) first occurs in the writings of Pliny and Galen, and was obviously derived from the old German word *sepe:* for the knowledge of this useful compound seems first to have arisen among the Gauls and Germans.

Hard soap is made by mixing soda of commerce with a sufficient quantity of lime and water to deprive it of its carbonic acid, drawing off the ley, and boiling it with a quantity of olive oil or tallow, amounting to six times the weight of the soda used. When sufficiently boiled, a quantity of common salt is added, which induces the soap to separate from the water, and to float upon the surface. Though in this country, where kelp is usually employed, at least in part, to furnish the soda, the quantity of common salt present from the beginning is usually sufficient without any addition. The soap is then poured into proper vessels, and when cold cut into parallelopipeds. Whale oil has been tried, but found improper for making hard soap. In this country, tallow is usually employed. In France, and the south of Europe, olive oil is used. When oil or tallow alone is used, the soap has a white colour; but it is usual to add a quantity of rosin, which gives it a yellow colour, and a softer consistence. It is then called *yellow* soap.

The appearance and properties of common soap are so well known, that it is unnecessary to describe it. The various uses to which it is applied are equally well known. It dissolves in alcohol, but is precipitated by the addition of water. With water it readily mixes, though it does not, strictly speaking, dissolve in that liquid, as most of it is separated by the filter. A specimen of white soap analysed by Darcet, Lelievre, and Pelletier, was composed of

60.94	oil,
8.56	alkali,
30.50	water.
100.00	

Sp. 2. *Soap of Potash*, or *Soft Soap.* When potash is substituted for soda, the soap never hardens by cooling, but remains always soft. Whale oil is said to be employed in the manufacture of soft soap. A little tallow is also added, which, by peculiar management, is dispersed through the soap in fine white spots. The properties of soft soap are too well known to need description. It is the only species of soap with which the ancients were acquainted. It is but little used in this country in comparison of hard soap.

Sp. 3. *Soap of Ammonia.* This soap may be formed by digesting carbonate of ammonia on soap of lime. Its taste is more pungent than that of common soap. It mixes sparingly with water, but is pretty soluble in alcohol. The substance employed as an external application by surgeons under the name of *volatile liniment*, is scarcely any thing else than this soap.

Sect. II. *Of Earthy Soaps.*

The earthy soaps differ essentially from the alkaline, in being insoluble in water, and therefore incapable of being used as detergents. They are formed whenever a solution of common soap in water is mixed with that of an earthy salt. Hence the reason that all waters holding an earthy salt in solution are unfit for washing. They decompose the common soap, and form a soap insoluble in water. Such waters are called *hard*, and are very frequent, especially in pit wells.

All the earthy soaps are insoluble in alcohol, except soap of magnesia, which dissolves both in alcohol and fixed oils. The earthy soaps are all white, and require a considerable heat to melt them.

Sect. III. *Of Metallic Soaps.*

The metallic soaps may be formed in the same way as the earthy soaps. They are insoluble in water, and cannot be used as detergents; but several of them are soluble in alcohol and in fixed oils. The greater number of them have a white colour; but soap of cobalt is of a leaden colour; soap of iron, reddish-brown; and soap of copper, green. Berthollet, who examined these soaps, has recommended some of them as paints.

Some of the metallic oxides, as those of mercury, lead, and bismuth, when mixed with fat oils and water, and boiled, form an intimate combination with the oil, used by surgeons under the name of *plaster*. Litharge is the metallic substance commonly used for these compounds, and olive oil answers better than any other hitherto tried. These plasters soften when heated, and adhere very strongly to the skin when spread thin upon linen or leather, but they may be drawn off by using the requisite force, without leaving any portion adhering to the skin. In these properties their excellence consists.

BOOK III.

OF AFFINITY.

Having taken a view of the different substances which constitute the objects of chemistry, it remains for us to make a few remarks on the force by which different bodies are united together, and kept in combination. This force has received the name of *affinity*.

All the great bodies which constitute the solar system are urged towards each other by a force which preserves them in their orbits, and regulates their motions. This force has received the name of *attraction*. Newton demonstrated that this force is the same with *gravitation*, or the force by which a heavy body is urged towards the earth.

When two bodies are brought within a certain distance, they adhere together, and require a considerable force to separate them. Hence it appears that bodies are not only attracted towards the planetary bodies, but towards each other. In all cases we find the particles of matter united together in masses, differing indeed in magnitude, but containing all of them a considerable number of particles. These particles remain united, and cannot be separated without the application of a considerable force.

Thus we see that there is a certain unknown force which urges bodies towards each other; a force which acts not only upon large masses of matter, but upon the particles of which bodies are composed. Attraction, therefore, as far as we know, extends to all matter, and exists mutually between all matter.

The change which attraction produces on bodies is a diminution of their distance. Now the distances of bodies from each other are of two kinds, either too small to be perceived by our senses, or great enough to be easily perceived and estimated. Hence the attractions of bodies, as far as regards us, naturally divide themselves into two classes. 1. Those which act at sensible distances from each other. 2. Those which act at insensible distances. It is to the second of these attractions that the term *chemical affinity* has been given.

Chemical affinity then is the attraction which exists between the particles of bodies, which urges them towards each other, and keeps them united. Now the particles of matter are of two kinds, either *homogeneous* or *heterogeneous*. By homogeneous particles are meant the particles which compose the same body; by heterogeneous, those which compose different bodies. Thus the particles of iron are homogeneous; but a particle of iron and a particle of lead are heterogeneous.

Homogeneous affinity urges the homogeneous particles towards each other, and keeps them united. It is usually denoted by the term *cohesion*, and sometimes by *adhesion*, when the surfaces of bodies only are referred to.

Heterogeneous affinity urges heterogeneous particles towards each other, and keeps them at insensible distances, and of course is the cause of the formation of new integrant particles composed of a certain number of heterogeneous particles.

Affinity, like sensible attraction, varies with the distance of the attracting bodies; but the rate at which it varies remains still unknown. The characteristic marks of affinity may be reduced to the three following.

1. It acts only at insensible distances, and of course affects only the particles of bodies.

2. Its force is always the same in the same particles, but it is different in different particles.

3. This difference is not affected by the mass. Thus, if A have a greater affinity for C than B has, the mass of B may be considerably increased, while that of A remains unchanged, yet B is not capable of taking a part of C from A.* Let us now take a particular view of gases, liquids, and solids, that we may ascertain in what way they unite, and how far their combinations are influenced by the state of the bodies themselves.

Chap. I.

Of Gases.

Gases are elastic fluids, which yield to the smallest impression, and have their parts easily moved. Their elasticity varies with the pressure, and hence it follows that their particles mutually repel inversely as the distances of their centres from each other. The gaseous bodies at present known (including some vapours) amount to 22. The following table exhibits their names and their specific gravity.

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* This is the law for many years received by chemists as an axiom, and illustrated by Bergman at great length. It was lately called in question by Berthollet. But the experiments on which his opinion was founded, have not stood the test of repetition.

Gases.	Specific Gravity.
Air	1.000
Chloric gas	2.713
Nitric acid	2.427
Sulphurous acid	2.097
Vapour of ether	2.250
Vapour of alcohol	2.100
Muriatic acid	1.278
Fluoric acid	——
Nitrous oxide	1.603
Carbonic acid	1.518
Sulphureted hydrogen	1.147
Oxygen	1.093
Nitrous gas	1.038
Azote	0.969
Carbonic oxide	0.956
Olefiant gas	0.974
Steam	0.700
Ammonia	0.600
Carbureted hydrogen	0.555
Arsenical hydrogen	0.529
Phosphureted hydrogen	0.852
Hydrogen	0.074

The gases usually contain water. This liquid, in most of them, is in the state of vapour, and intimately united. It may be partly separated by cold, or by substances which have a strong affinity for water, as sulphuric acid, dry muriate of lime, and the dry fixed alkalies. From the experiments of Saussure we learn, that a hundred cubic inches of air saturated with moisture at the temperature of 57° contain 0.35 of a grain troy of moisture.*

When gaseous bodies are brought into contact with each other, they mix equably, how much sover they differ in specific gravity; and when once mixed, they never after separate. By this mixture, neither the bulk nor the specific gravity of the gaseous bodies is altered. This mutual mixture seems to be analogous to what happens when liquids are mixed together, and seems explicable in the same way. It seems to be owing to a weak attraction which exists between the particles of all gaseous bodies. Mr Dalton affirms, that it is owing entirely to the difference between the size of the particles of different gases.

Several gases have the property of uniting intimately with each other, and of forming new products possessing peculiar properties. The following table exhibits a view of those that unite upon simple mixture with the products which they form.

	Products.
Oxygen with nitrous gas	Nitrous acid. Nitric acid.
Ammonia with vapour	Liquid ammonia.
muriatic acid	Muriate of ammonia.
fluoric acid	Fluate of ammonia.
carbonic acid	Carbonate of ammonia.
sulphurous acid	Sulphite of ammonia.
sulphureted hydrogen	Hydrosulphuret of ammonia.

The following are the gases which combine only in particular circumstances with the products which they form.

	Products.
Oxygen with hydrogen	Water.
carbonic oxide	Carbonic acid.
azote	Nitric acid.
sulphurous acid	Sulphuric acid.
nitrous oxide	Nitric acid.

The combination of the first two sets is produced by combustion, and may be accomplished either by a red heat, or by the electric spark. Oxygen and azote unite slowly by means of electric sparks, but without combustion. Little is known of the way in which the remaining sets combine.

From the experiments hitherto made, it follows, that when gaseous bodies unite, they unite either in equal bulks of each, or two or three parts by bulk of one, unite with one part by bulk with the other. The following table exhibits a view of the proportions of the different constituents by bulk, of various compounds formed by the union of elastic fluids.

Compounds.	*Constituents by bulk.*	
Muriate of ammonia	100 ammoniacal	100 muriatic acid gas
Carbonate of ammonia	100 ditto	100 carbonic acid gas
Subcarb. of ammonia	100 ditto	50 ditto
Water	100 hydrogen gas	50 oxygen gas
Nitrous oxide	100 azotic gas	50 ditto
Nitrous gas	100 ditto	100 ditto
Nitric acid	100 ditto	200 ditto
Nitric acid	200 nitrous gas	100 ditto
Nitrous acid	300 ditto	100 ditto
Ammonia	100 azotic gas	300 hydrogen
Sulphuric acid	100 sulphurous acid	50 oxygen
Oxymuriatic acid	300 muriatic acid	100 ditto
Carbonic acid	100 carbonic oxide	50 ditto

Some gases, when mixed together, have the property of mutually decomposing each other. The following is a list of these gases.

Oxygen with	phosphureted hydrogen
Sulphureted hydrogen with	nitrous gas
	sulphurous acid

Many gases decompose each other by combustion, produced either by electric sparks, or by a red-hot body. The following are the principal of these gases.

Oxygen with	sulphureted hydrogen
	carbureted hydrogen
	olefiant gas
	vapour of ether
	——— alcohol
Nitrous oxide with	hydrogen
	phosphureted hydrogen
	sulphureted hydrogen
	carbonic oxide
	carbureted hydrogen
	olefiant gas
	vapour of ether
	——— alcohol
Nitrous gas with	hydrogen
	sulphurous acid
Hydrogen with	sulphurous acid
	carbonic acid
Vapour of water with	carbureted hydrogen
	olefiant gas

Water absorbs a certain portion of all the gases. Some of them are absorbed only in small quantity by that liquid, others in large quantity. The following table exhibits the bulk of each gas absorbed by 100 parts of water freed from air by boiling, as determined by the experiments of Dr Henry and Mr Dalton.

Gases.	Absorption according to Henry	Dalton.
Carbonic acid . . .	108	100
Sulphureted hydrogen	106	100
Nitrous oxide . . .	86	100
Olefiant gas	——	12.5
Nitrous gas	5	3.7
Oxygen gas	3.7	3.7
Phosphureted hydrogen	2.14	
Carbureted hydrogen .	1.4	3.7
Azotic gas	1.53	1.56
Hydrogen	1.61	1.56
Carbonic oxide . . .	2.01	1.56

Dr Henry's numbers are the result of experiment: Mr Dalton's of experiment modified a little by a happy generalization. He conceives that the degree of the absorption of each of the four sets, into which the gases are divided by the horizontal lines in the preceding table, may be represented as follows:

First set, Water absorbs its own bulk $= \frac{1}{1^3}$
Second set, ———— $\frac{1}{8}$th its bulk $= \frac{1}{2^3}$
Third set, ———— $\frac{1}{27}$ ———— $= \frac{1}{3^3}$
Fourth set, ———— $\frac{1}{64}$ ———— $= \frac{1}{4^3}$

From this generalization, which holds at least very nearly, it follows that the density of the gases, after absorption, is either the same as before it, or at least some submultiple of it, and the distance between their particles is either the same as before, or twice, thrice, or four times as great.

Dr Henry has shown, that whatever be the density of the gas, the bulk of it absorbed is always the same. If carbonic acid gas be reduced by pressure to twice the usual density, water still continues to absorb its own bulk of it. Hence by increasing the pressure, water may be made to absorb any *quantity* of a gas whatever.

The gases still retain their elasticity after they have been absorbed by water, accordingly they make their escape if the water be placed under the exhausted receiver of an air pump.

The proportion of a gas absorbed by water, depends very much upon its purity. Thus water absorbs its own bulk of pure carbonic acid gas; but if the carbonic acid gas be mixed with common air, the proportion of it absorbed is much diminished. Water impregnated with a gas must be in contact with a portion of the very gas absorbed, otherwise that gas soon makes its escape altogether.

As the temperature increases, the absorbability of the gases by water diminishes, no doubt in consequence of the increased elasticity of the gases.

This absorption of the gases by water is probably the consequence of an affinity between them and that liquid. Hence the determinate proportion of each absorbed, and most of the other phenomena, admit of an easy explanation.

The alkaline and acid gases are very absorbable by water, and of course are acted on by a strong affinity. The following Table exhibits a view of the bulk of each gas absorbed by one measure of water.

Sulphurous acid,	33
Fluoric acid .	175+
Muriatic acid, .	516
Ammoniacal gas,	780

When a cubic inch of water is saturated with these gases, its bulk increases. The following Table exhibits the bulk of water when thus saturated, supposing the original bulk to have been 1.

Saturated with

Sulphurous acid,	1,040
Muriatic acid .	1.500
Ammoniacal, .	1.666

Thus the water undergoes an expansion, so that the density of the gases absorbed is not in reality so great as it appears to be. The following Table exhibits the real densities of these gases in the water.

Sulphurous, . .	$31.7 = 3^3$ nearly.
Muriatic . . .	$344.0 = 7^3$
Ammonia, . . .	$468.0 = 8^3$

That these gaseous bodies combine chemically with water, cannot be doubted.

The simple gases have the property of combining with different solid bodies, and of forming compounds sometimes gaseous, sometimes liquid, and sometimes solid. Oxygen combines with two doses of carbon, forming carbonic acid, and carbonic oxide, both gases; the first a product of combustion, the second a combustible oxide. It combines with three doses of phosphorus, forming oxide of phosphorus, phosphorous acid, and phosphoric acid, all of which are solid bodies. It unites likewise with three doses of sulphur, and forms oxide of sulphur, sulphurous acid, and sulphuric acid; the first a solid, the second a gas, the third a liquid. It combines in various proportions with the metals, and all the metallic oxides are solids.

Hydrogen appears to combine in at least two proportions with each of the other simple combustibles. It unites also with several of the metals, but the proportions have not been ascertained.

CHAP. II.

Of Liquids.

A LIQUID is a fluid, not sensibly elastic, the parts of which yield to the smallest impression, and move easily upon each other. All liquids have a certain cohesive force by which their particles are retained together, and this force is much greater in mercury than in water. The following Table exhibits a list of liquids, with their relative specific gravities.

Water	1.000
Ethers	0.632 to 0.900
Prussic acid . . .	0.705
Petroleum . . .	0.730 to 0.878
Volatile oils . . .	0.792 to 1.094
Alcohol	0.796
Fixed oils . . .	0.913 to 0.968
Supersulphureted hydrogen	——
Nitric acid . . .	1.583
Sulphuric acid . .	1.885
Phosphuret of sulphur .	——
Mercury . . .	13.568

Most substances are rendered liquid by heat; but these are the only bodies that are permanently liquid in this country.

Some liquids may be mixed, and of course combine in any proportion whatever. In this respect they resemble the gases. The following is a list of these liquids:

Water with .	alcohol. nitric acid. sulphuric acid.
Alcohol with .	ether.
Sulphuric acid with	nitric acid.
Fixed oils with .	petroleum. volatile oils. fixed oils.
Volatile oils with	petroleum. volatile oils.

These liquids, when once mixed, form a homogeneous compound, and do not afterwards separate again. The union is attended with the evolution of heat, and with a certain degree of condensation, for the specific gravity is always greater than the mean.

The following Table exhibits a list of those liquids that unite with each other only in certain proportions.

Water with .	ether. volatile oils.
Alcohol with .	volatile oils. petroleum. phosphuret of sulphur.
Ether with .	volatile oils. petroleum.
Volatile oils with	petroleum.

The following Table exhibits a list of the most remarkable liquids that do not sensibly combine:

Water with .	petroleum. fixed oils. supersulphureted hydrogen.
Fixed oils with .	ether.
Mercury with .	water. alcohol. ether. volatile oils. petroleum.

No doubt the action of liquids on each other depends upon their affinity. The first class have the greatest affinity for each other; that of the second is greater, and that of the third is less, than the cohesion of the particles of each.

Water has the property of combining with a very great number of solid bodies. It combines with them in two ways. In the first way, the solid retains its solidity, while the water loses its liquid form. Such combinations are called *hydrates*. In this way water combines with sulphur, metallic oxides, earths, alkalies, many acids, all salts, hydrosulphurets, and many animal and vegetable substances. In the second way, the water dissolves the solid, and the whole becomes liquid. In this way it acts upon many acids, alkalies, earths, salts, and vegetable substances.

These combinations are all chemical, and the hydrates appear to be the most intimate. Their specific gravity is always greater than the mean, while the specific gravity of saline solutions is usually less than the mean.

The action of the other liquids on solids has been hitherto but imperfectly investigated.

Chap. III.

Of Solids.

Solids are bodies composed of particles that cohere together, and cannot be moved among themselves, without the exertion of a force sufficient to destroy the cohesion of the body. They are very numerous, and their specific gravity varies more than that of gases or liquids. The following Table exhibits the specific gravity of the most remarkable solids:

	Sp. Gravity.
Charcoals . . .	0.223 to 1.526
Vegetable bodies . .	0.240 to 1.354
Salts	0.273 to 7.176
Earths	0.346 to 4.842
Solid acids . . .	0.667 to 3.391
Earthy compounds . .	0.680 to 4.815
Bitumens and solid oils .	0.892 to 1.357
Fixed alkalies . .	1.336 to 1.708
Phosphorus . . .	1.770
Carburets of iron . .	1.987 to 7.840
Sulphur . . .	1.990
Glass	2.732 to 3.329
Carbon	3.518 to 3.531
Metallic sulphurets .	3.225 to 10.000
Metals and alloys and oxides	0.600 to 23.00

The following solids combine with each other in any proportion whatever.

Sulphur with phosphorus.
Carbon with iron?
Metals with most metals.
Protoxide of antimony with sulphuret of antimony.
Earths with earths.
Earths with some metallic oxides.
Some earths with fixed alkalies.
Fixed alkalies with solid oils.
Solid oils with each other and with bitumen.

All these combinations are produced by means of heat; unless they be brought into fusion, or at least one of them, they do not combine.

The following Table exhibits the principal solids, which have been observed to unite only in determinate proportions:

Sulphur with	metals. some metallic oxides. earths. fixed alkalies?
Phosphorus with .	carbon. metals. some earths.
Acids with . .	alkalies. earths. metallic oxides.

These combinations are more intimate than the preceding, they have been more accurately examined, and are better known. They never take place, unless one of the bodies at least be brought first into a liquid state, either by means of heat, or by solution in water.

The salts are the most important of these combinations, and a vast number of experiments have been made, in order to ascertain the proportions in which their constituents combine. The following Table exhibits the general result of these experiments. The numbers represent the weight of the different acids and bases which neutralize each other respectively.

Acids.		Bases.	
Sulphurous . . .	54	Barytes . . .	72.8
Oxalic	39.5	Strontian . . .	46
Nitric	33.3	Potash . . .	42.11
Sulphuric . . .	37.5	Soda	29.75
Phosphoric . . .	23	Lime	27.2
Muriatic	18	Magnesia . .	17.76
Carbonic	20.5	Ammonia . .	9
Phosphorous . .	32		

Suppose we wish to form sulphate of barytes—from the above Table, it appears that we must unite together 37.5 parts by weight of sulphuric acid, and 72.8 parts of barytes.

From various experiments hitherto made, it appears that the supersalts contain twice as much acid, and the subsalts twice as much base, as the neutral salts. Suppose that a given quantity of sulphate of potash is composed of 100 potash, united with x of sulphuric acid, then supersulphate of potash is composed of 100 potash, united with $2x$ sulphuric acid. The triple salts appear to consist of two different salts united together. Thus alum may be considered as a compound of *sulphate of potash* and *sulphate of alumina*.

According to the old doctrine of affinity delivered by Bergman, all bodies capable of combining have an affinity for each other. This affinity is a constant force, which may be represented by numbers. Affinity is *elective*; that is to say, if a has a stronger affinity for m than b has, and if m be combined with b, forming a compound which we may represent by mb; a, upon being mixed with this compound, has the property of separating b completely from m, and taking its place, so as to form a compound ma, while b is entirely disengaged. This doctrine has been lately called in question by Berthollet. According to Berthollet, affinity is not elective,* and never occasions decomposition, but only combination. The decompositions which take place are owing to other causes, such as insolubility, elasticity, &c. though this new opinion (if accurate) renders Bergman's tables of decomposition of little comparative value; yet, as it is, seems inconsistent with facts, and as his tables are in some cases useful, and are often referred to, it has been thought worth while to subjoin them here.

Table of Chemical Decompositions.

I.
ALKALIES.
—
Sulphuric acid
Nitric
Muriatic
Phosphoric
Fluoric
Oxalic
Tartaric
Arsenic
Succinic
Citric
Formic
Benzoic
Acetic
Saclactic
Boracic
Sulphurous
Nitrous
Carbonic
Prussic

II.
BARYTES AND STRONTIAN
—
Sulphuric
Oxalic
Succinic
Fluoric
Phosphoric
Saclactic
Nitric
Muriatic
Suberic
Citric
Tartaric
Arsenic
Benzoic
Acetic
Boracic
Sulphurous
Nitrous
Carbonic
Prussic

III.
LIME.
—
Oxalic
Sulphuric
Tartaric
Succinic
Phosphoric
Saclactic
Nitric
Muriatic
Suberic
Fluoric
Arsenic
Citric
Malic
Benzoic
Acetic
Boracic
Sulphurous
Nitrous
Carbonic
Prussic.

IV.
MAGNESIA
—
Oxalic
Phosphoric
Sulphuric
Fluoric
Arsenic
Saclactic
Succinic
Nitric
Muriatic
Tartaric
Citric
Malic
Benzoic
Acetic
Boracic
Sulphurous
Nitrous
Carbonic
Prussic

V.
ALUMINA.
—
Sulphuric
Nitric
Muriatic
Oxalic
Arsenic
Fluoric
Tartaric
Succinic
Saclactic
Citric
Phosphoric
Benzoic
Acetic
Boracic
Sulphurous
Nitrous
Carbonic
Prussic.

VI.
OXIDE OF GOLD.
—
Muriatic acid
Nitric
Sulphuric
Arsenic
Fluoric
Tartaric
Phosphoric
Prussic.

VII.
OXIDE OF SILVER.
—
Muriatic acid
Oxalic
Sulphuric
Saclactic
Phosphoric
Sulphurous
Nitric
Arsenic
Fluoric
Tartaric
Citric
Formic
Acetic
Succinic
Prussic
Carbonic.

VIII.
OXIDE OF MERCURY.
—
Muriatic
Oxalic
Succinic
Arsenic
Phosphoric
Sulphuric
Saclactic
Tartaric
Citric
Sulphurous
Nitric
Fluoric
Acetic
Boracic
Prussic
Carbonic

IX.
OXIDE OF COPPER.
—
Oxalic acid
Tartaric
Muriatic
Sulphuric
Saclactic
Nitric
Arsenic
Phosphoric
Succinic
Fluoric
Citric
Formic
Acetic
Boracic
Prussic
Carbonic.

X.
OXIDE OF IRON.
—
Oxalic acid
Tartarous
Camphoric
Sulphuric
Saclactic
Muriatic
Nitric
Phosphoric
Arsenic
Fluoric
Succinic
Citric
Formic
Acetic
Boracic
Prussic
Carbonic.

XI.
OXIDE OF NICKEL.
—
Oxalic acid
Muriatic
Sulphuric
Tartaric
Nitric
Phosphoric
Fluoric
Saclactic
Succinic
Citric
Formic
Acetic
Arsenic
Boracic
Prussic
Carbonic.

XII.
OXIDE OF TIN.
—
Tartaric acid
Muriatic
Sulphuric
Oxalic
Arsenic
Phosphoric
Nitric
Succinic
Fluoric
Saclactic
Citric
Formic
Acetic
Boracic
Prussic

XIII
OXIDE OF LEAD.
—
Sulphuric acid.
Saclactic
Oxalic
Arsenic
Tartaric
Muriatic
Phosphoric
Sulphurous
Suberic
Nitric
Fluoric
Citric
Formic
Acetic
Boracic
Prussic
Carbonic.

XIV.
OXIDE OF ZINC.
—
Oxalic acid
Sulphuric
Muriatic
Saclactic
Nitric
Tartaric
Phosphoric
Citric
Succinic
Fluoric
Arsenic
Formic
Acetic
Boracic
Prussic
Carbonic.

XV.
OXIDE OF BISMUTH.
—
Oxalic acid
Arsenic
Tartaric
Phosphoric
Sulphuric
Muriatic
Benzoic
Nitric
Fluoric
Saclactic
Succinic
Citric
Formic
Acetic
Prussic
Carbonic

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* It appears to me impossible to conceive any propriety in the term *elective*, as applied to the inanimate particles of chemical combination: The affinities exerted are at all times *compulsive*; and this term I think is better adapted to the real state of the case. COXE.

Table of Chemical Decompositions.—Continued.

XVI.
OXIDE OF ANTIMONY.
—
Muriatic acid
Benzoic
Oxalic
Sulphuric
Nitric
Tartaric
Saclactic
Phosphoric
Citric
Succinic
Fluoric
Arsenic
Formic
Acetic
Boracic
Prussic
Carbonic.

XVII.
OXIDE OF ARSENIC.
—
Muriatic acid
Oxalic
Sulphuric
Nitric
Tartaric
Phosphoric
Fluoric
Saclactic
Succinic
Citric
Formic
Arsenic
Acetic
Prussic

XVIII.
OXIDE OF COBALT.
—
Oxalic acid
Muriatic
Sulphuric
Tartaric
Nitric
Phosphoric
Fluoric
Saclactic
Succinic
Citric
Formic
Acetic
Arsenic
Boracic
Prussic
Carbonic.

XIX.
OXIDE OF MANGANESE.
—
Oxalic acid
Citric
Phosphoric
Tartaric
Fluoric
Muriatic
Sulphuric
Nitric
Saclactic
Succinic
Tartaric
Formic
Acetic
Prussic
Carbonic

XX.
OXIDE OF TITANIUM
—
Phosphoric acid
Arsenic
Oxalic
Sulphuric
Muriatic
Nitric
Acetic

XXI.
SULPHURIC ACID.
—
Barytes
Strontian
Potash
Soda
Lime
Magnesia
Ammonia
Glucina
Yttria
Alumina
Zirconia

XXII.
SULPHUROUS ACID.
—
Barytes
Lime
Potash
Soda
Strontian
Magnesia }
Ammonia }
Glucina
Alumina
Zirconia

XXIII.
PHOSPHORIC ACID.
—
Barytes
Strontian
Lime
Potash
Soda
Ammonia
Magnesia
Glucina
Alumina
Zirconia

XXIV.
PHOSPHOROUS ACID.
—
Lime
Barytes
Strontian
Potash
Soda
Ammonia
Glucina
Alumina
Zirconia

XXV.
CARBONIC ACID.
—
Barytes
Strontian
Lime
Potash
Soda
Magnesia
Ammonia
Glucina
Zirconia.

XXVI.
NITRIC ACID.
—
Barytes
Potash
Soda
Strontian
Lime
Magnesia
Ammonia
Glucina
Alumina
Zirconia.

XXVII.
XXVIII.
MURIATIC AND ACETIC ACIDS.
—
Barytes
Potash
Soda
Strontian
Lime
Ammónia
Magnesia
Glucina
Alumina
Zirconia.

XXIX.
OXYMURIATIC ACID.
—
Potash
Soda
Barytes
Strontian
Lime
Ammonia
Magnesia
Alumina.

XXX.
XXXI.
XXXII.
XXXIII.
FLUORIC, BORACIC, ARSENIC, AND TUNGSTIC ACIDS.
—
Lime
Barytes
Strontian
Magnesia
Potash
Soda
Ammonia
Glucina
Alumina
Zirconia

XXXIV.
OXALIC ACID.
—
Lime
Barytes
Strontian
Magnesia
Potash
Soda
Ammonia
Alumina.

XXXV.
CITRIC ACID.
—
Lime
Barytes
Strontian
Magnesia
Potash
Soda
Ammonia
Alumina
Zirconia.

XXXVI.
BENZOIC ACID.
—
Potash
Soda
Ammonia
Barytes
Lime
Magnesia
Alumina

XXXVII.
SUCCINIC ACID.
—
Barytes
Lime
Potash
Soda
Ammonia
Magnesia
Alumina

XXXVIII.
CAMPHORIC ACID.
—
Lime
Potash
Soda
Barytes
Ammonia
Alumina
Magnesia

XXXIX.
SUBERIC ACID.
—
Barytes
Potash
Soda
Lime
Ammonia
Magnesia
Alumina

XL.
PRUSSIC ACID.
—
Barytes
Strontian
Potash
Soda
Lime
Magnesia
Ammonia.

XLI.
FIXED OILS.
—
Lime
Barytes
Fixed alkalies
Magnesia
Ammonia
Oxide of mercury
Other metallic oxides.
Alumina.

PART II.

CHEMICAL EXAMINATION OF NATURE.

HAVING in the First Part of this article given a sufficient detail of the principles of Chemistry, and described the substances which are usually employed as instruments of investigation, it remains for us now to take a view of the different substances, as they exist in nature, constituting the material world, that we may ascertain how far the science of Chemistry will serve towards explaining their nature, and accounting for the various changes which they produce on each other. Now the different substances of which the material world, as far as we have access to it, is composed, may be arranged under the five following heads:

1. The Atmosphere.
2. Waters.
3. Minerals.
4. Vegetables.
5. Animals.

We shall take a view of each of these in succession.

BOOK I.

OF THE ATMOSPHERE.

The atmosphere is that invisible fluid which surrounds the earth to an indeterminate height, and which got its name from the Greeks, in consequence of the vapours that are continually floating in it. Two things respecting it claim our attention; 1. Its composition. 2. The changes which take place in it.

CHAP. I.

Of the Composition of the Atmosphere.

For all the knowledge of the atmosphere which we possess, we are indebted to the moderns. The ancients made no progress in the investigation. Its weight was determined by Galileo, and his disciple Torricelli; its density, elasticity, and most of its mechanical properties, by Boyle; its relation to light and sound, by Hooke, Newton, and Derham; but for our knowledge of its composition, we are indebted to the labours of the chemists of the last century. Hales began the subject. Dr Black made an additional step. Dr Priestley discovered the substances of which it is composed. But Scheele and Lavoisier were the philosophers who first placed the subject in its true light; and the matter was in some measure completed by Mr Cavendish. The atmosphere consists always of the three following distinct parts. 1. Air. 2. Water. 3. Carbonic acid.

SECT. I. *Of Air.*

The word AIR is often used to denote the atmosphere in general; but in strict language it is applied to an elastic fluid, which constitutes by far the greatest portion of the atmosphere, and which is distinguished from the moisture and carbonic acid with which it is always mixed.

Air is an invisible elastic fluid. Its specific gravity is always reckoned 1,000; and its weight is such, that, at the temperature of 60°, and when the barometer stands at 30 inches, 100 cubic inches of dry air weigh 30.5 grains troy.

Its density always increases with the pressure, so that its bulk is always inversely as the pressure. Air itself, though it has the property of refracting light, is invisible. The blue colour of the sky is owing to the vapours with which the air is always mixed; and it depends upon the quantity of these vapours.

Air was determined by Scheele to be a mixture of oxygen gas and azotic gas; and this conclusion was confirmed by the experiments of Lavoisier, and of all subsequent chemists. Scheele determined the proportion of these two gases to be 27 by bulk of oxygen gas, and 73 of azotic gas. In these proportions M. Lavoisier acquiesced. Their method was to absorb the oxygen from a given bulk of atmospheric air, and to determine its quantity by the diminution of bulk. Mr Cavendish first demonstrated, that the proportion determined by Scheele and Lavoisier was inaccurate. He found air a mixture of 21 parts by bulk of oxygen gas, and 79 of azotic, very nearly. These proportions were confirmed by Berthollet, Davy, De Marti, and many other chemists, and are now universally acceded to.

The method of analysing atmospheric air is to abstract its oxygen, by means of some substance which has a strong affinity for it. The apparatus is usually called a *eudiometer*; because it was supposed at first that the proportion of oxygen in air is variable, and that the goodness of air depends upon the greatness of this proportion. And the name has been retained after this opinion has been given up.

The first eudiometer used was by Dr Priestley. It consisted in mixing 100 measures of air and 100 of nitrous gas in a tube. The goodness of the air was judged of by the greatness of the diminution. This method was improved by Fontana, and is usually distinguished by the name of the eudiometer of Fontana. Many attempts have been made to render it accurate; but it is in reality not much to be trusted, because the diminution of bulk varies with a variety of circumstances, which cannot easily be appreciated. It is greatest when a wide vessel is used, and least when the mixture is made in a narrow tube. According to Dalton, 21 measures of oxygen unite either with 36 measures of nitrous gas, or with $36\times2=72$ measures. The first proportion takes place in a narrow tube; the second in a wide vessel; in intermediate vessels the proportions are intermediate. Hence he uses a narrow tube. He lets up 100 measures of air, and then adds 50, or any greater number of measures of nitrous gas. The mixture takes place slowly, and the bulk gradually diminishes. In a few minutes, the diminution of bulk will have reached its maximum. Note it down, and multiply it by $\frac{7}{19}=0.3684$. The product is the quantity of oxygen which the air examined contained. Suppose 100 measures of air to be examined, and the diminution of bulk to be 57;

$$57\times0.3684=20.9988, \text{ or very nearly } 21.$$

This would indicate the oxygen in the air examined to be 21 measures. This method affords a tolerable approximation; but the error is generally greater than 1 per cent.

To avoid the ambiguity occasioned by the unequal diminution of bulk which takes place when air and nitrous gas are mixed, Mr Davy takes a strong solution of green sulphate of iron, makes it absorb a quantity of nitrous gas, and then agitates this liquid in the air to be examined. The whole oxygen is absorbed, and the diminution of bulk determines exactly how much oxygen the air contained. This method may be used, and is susceptible of great accuracy. The only objection to it, is the slowness with which the absorption of the oxygen takes place.

The liquid, made by boiling a mixture of lime and sulphur in a phial of water, which is yellow, may also be used with considerable precision. It was employed by Scheele, and in an improved form by De Morti. A stick of phosphorus in summer, may likewise be used with advantage. The residual gas ought to be agitated in water, to deprive it of a little phosphorus, which it usually holds in solution, and which may increase its bulk a little.

But the best method of analysing air is the following, which was first put in practice by Volta, and is therefore called Volta's eudiometer. Mix equal bulks of air and hydrogen gas together, and pass an electric spark through the mixture. Combustion takes place. Note the diminution of bulk; one-third of that diminution is equal to the bulk of oxygen which the air examined contained.

The result of all the trials hitherto made, gives us air a mixture of 21 measures of oxygen, and 79 of azote, or by weight, of

22.91	oxygen,
77.09	azote.
100.00	

SECT. II. *Of Water*

That water is always present in the atmosphere, is obvious from the clouds which constantly form in it, and from the rain and dew which are so frequently falling from it. Various instruments have been contrived to point out the quantity of water which the atmosphere contains. These instruments are called *hygrometers*. None of them are unexceptionable; but, upon the whole, the one contrived by Professor Leslie seems to be the best. From these instruments we learn, that the quantity of water in the atmosphere is exceedingly various. Sometimes very little can be detected, and sometimes the air is quite saturated with it.

From the experiments of Saussure, we learn, that a cubic foot of air, at the temperature of 66°, is capable of holding only about 8 grains troy, or $\frac{1}{67}$th its weight of water. The quantity increases with the temperature, and, according to Leslie, doubles for every additional 27° of temperature. Hence it is obvious, that the quantity of water in air depends, in some degree, on the temperature. At low temperatures, very little water can be present; but at high temperatures, air can contain a considerable quantity.

With respect to the state in which the water is contained in the air, there are two opinions which have divided philosophers. The first opinion is, that the water is dissolved by the air, and held in solution by it precisely as sugar or salt is by water. This opinion was started by Dr Hooke, explained at considerable length by Dr Halley, and fully discussed and supported by Leroy and Hamilton. The second opinion is, that the water is first converted into vapour, and that in that state it mixes with air precisely as one elastic fluid with another. This opinion, though with different modifications, was supported both by Saussure and Deluc, and has lately been maintained by Dalton, with arguments that appear decisive.[*] When water evaporates or enters into air, it always produces cold, indicating a conversion into vapour. The same quantity of water evaporates, and continues in the state of vapour under an exhausted receiver, and in a receiver full of air. Vapour increases the bulk of air exactly in proportion to its quantity.

From the experiments of Dalton we learn, that in the torrid zone the quantity of vapour in the atmosphere varies, from being able to support a column of mercury 0.6 inch in height, to being able to support a column 1 inch high. In Britain it seldom amounts to 0.6, but in summer is frequently at 0.5 inch. In winter it is often as low as 0.1 inch.

From this it appears, that the quantity of vapour in the atmosphere varies from $\frac{1}{60}$th to $\frac{1}{300}$th part of the atmosphere by weight. Mr Dalton supposes the medium quantity at once in the atmosphere to amount to about $\frac{1}{76}$th of its bulk.

Sect. III. *Of Carbonic Acid.*

The existence of carbonic acid in the atmosphere became manifest, as soon as it had been determined by Dr Black, that alkalies owe their mild state to the presence of that gas. For it was known that a caustic alkali becomes gradually mild, when left exposed to the atmosphere. It has been found in air, upon the tops of mountains as well as in plains. Even air, brought by means of a balloon from the height of 4280 feet above the surface of the earth, was found to contain it. Hence we may conclude that it is universally diffused. The quantity of it is very small, and therefore determined with difficulty. At first it was conceived to amount to $\frac{1}{100}$th of the atmosphere, but it is certainly much less. Humboldt found it to vary from 0.005 to 0.01; but his method does not seem susceptible of precision. Dalton made it $\frac{1}{1400}$th of the air. Perhaps we shall not err far if we reckon it at a medium at $\frac{1}{1000}$th of the air. If we consider the numerous sources of this gas from the combustion of wood and coal, and the breathing of animals, it must appear surprising that its bulk does not sensibly increase. This can only be accounted for by supposing, that nature has provided some means to decompose it as fast as it is formed.

For an account of the changes which take place in the atmosphere, see Meteorology.

Book II. *Of Waters.* See the article Waters.

Book III. *Of Minerals.* See the articles Geognosy, Mineralogy, Oryctognosy.

BOOK IV.

OF VEGETABLES.

Vegetables are exceedingly numerous, nearly 40,000 species having been already described and arranged by botanists. It is the business of the chemist to analyse vegetables, to investigate the substances of which they are composed, the processes by which they are formed, and the changes to which they are subject after they have ceased to vegetate. We shall divide this Book into three Chapters. In the first, we shall give an account of the ingredients of plants; in the second, of the chemical phenomena of vegetation; and in the third, of the fermentations to which certain vegetable substances are liable, after they have ceased to vegetate.

Chap. I.

Of the Ingredients of Plants.

The substances hitherto found in the vegetable kingdom, all of them at least which have been examined with any degree of accuracy, may be reduced under four heads: I. Substances soluble in water, at least in some state or other, and which, in general, are solid and not remarkably combustible. II. Substances, either fluid, or which melt when heated, and burn like oil. They are all insoluble in water; but, in general, they dissolve in alcohol. III. Substances neither soluble in water, nor alcohol, nor ether, and which have a fibrous or woody texture. IV. Substances which belong to the mineral kingdom, which occur only in small quantity in vegetables, and may therefore be considered as extraneous or foreign. The following Table exhibits a view of the different vegetable substances hitherto discovered, arranged under their respective heads.

I. 1. Acids.
2. Sugar.
3. Sarcocoll.
4. Asparagin.
5. Gum.
6. Mucus.
7. Jelly.
8. Ulmin.
9. Inulin.
10. Starch.
11. Indigo.
12. Gluten.
13. Albumen.
14. Fibrin.
15. Bitter principle.
16. Extractive.
17. Tannin.
18. Narcotic principle.

II. *Oleoform.*

1. Fixed oil.
2. Wax.
3. Volatile oil.
4. Camphor.
5. Bird-lime.
6. Resins.
7. Guaiacum.
8. Balsams.
9. Gum resins.
10. Caoutchouc.

III. *Fibrous.*

1. Cotton.
2. Suber.
3. Wood.

IV. *Extraneous.*

1. Alkalies.
2. Earths.
3. Metals.

The properties of these different substances form the subject of the following Sections.

Sect. I. *Of Acids.*

The acids found ready formed in the vegetable kingdom are the following:—

1. Acetic.
2. Oxalic.
3. Tartaric.
4. Citric.
5. Malic.
6. Gallic.
7. Benzoic.
8. Prussic.
9. Phosphoric.

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[*] This opinion *may perhaps* be true; but how is it reconcilable with Black's theory of latent heat, which supposes water at 212° to take up nearly 1000° additional to convert it into vapour or steam? Whence can it acquire this quantity of heat at low temperatures; and especially how is the diminution of ice itself to be explained? Coxe.

The sulphuric, nitric, and muriatic acids, are likewise to be found in vegetables combined with alkalies, but only in small quantities.

1. Acetic acid has been detected in the sap of different trees, in the acid juice of the *cicer parietinum*, and in the *sambucus nigra*.

2. Oxalic acid, in the state of *superoxalate of potash*, exists in the leaves of the *oxalis acetosella*, *oxalis corniculata*, and different species of *rumex*. It exists uncombined in the juice of the *cicer parietinum*. In the state of *oxalate of lime* it is found in *rhubarb*, and in the roots and barks of a great variety of plants.

3. Tartaric acid is found in the pulp of the *tamarind*, in the juice of *grapes* and *mulberries;* likewise in the *rumex acetosa*, *rhus coriaria*, *rheum rhaponticum*, *agave americana*, *triticum repens*, *leontodon taraxacum*. In most of these plants it is in the state of supertartrate of potash.

4. Citric acid is found intermixed with other acids in the juice of *oranges* and *lemons*, and in the berries of *vaccinium oxycoccos*, *vaccinium vitis idæa*, *prunus padus*, *solanum dulcamara*, *rosa canina*. Mixed with other acids, it is common in many fruits. *Citrate of lime* is found in the onion.

5. Malic acid is very common in plants. It was found by Scheele, unmixed with any other acid, in the fruits of the following plants: the *apple*, *berberis vulgaris*, *prunus domestica*, *prunus spinosa*, *sambucus nigra*, *sorbus aucuparia*. Braconnot has found it in the leaves of most vegetables which he examined. Vauquelin found it in the state of *supermalate of lime* in the following plants; *sempervivum tectorum*, *sedum album*, *sedum acre*, *sedum telephium*, *arum maculatum*, and different species of *crassula* and *mesembrianthemum*. Mixed with citric acid, it constitutes the acid of the following fruits; *gooseberries*, *currants*, *bleaberries*, *cherries*, *strawberries*, *cloudberries*, *raspberries*. Sometimes, as in the tamarind, it is mixed with tartaric acid.

6. Gallic acid has been found in the bark of most astringent tasted trees, as elm, oak, horse-chesnut, beech, willow, elder, plum, sycamore, birch, cherry-tree, mountain-ash, poplar, hazel, ash, sumach.

7. Benzoic acid has been found only in a few vegetable substances, to which the name of *balsam* has been given. The chief of these are *benzoin*, *balsam of Tolu*, *storax*, *dragon's blood*.

8. Prussic acid has been found in the leaves of the *lauro-cerasus*, in *peach blossoms*, in the flowers of the *sloe*, in the leaves of the bay-leaved *willow* (*salix pentandra*), and in most bitter tasted kernels.

9. Phosphoric acid is very common in plants, but only in small quantities, and it is usually combined with potash or lime. Phosphate of potash exists in barley and other species of corn, so does phosphate of lime. Both of these salts exist in the leaves of many trees.

Sect. II. *Of Sugar.*

Common sugar is obtained from the juice of the *arundo sacharifera*, or *sugar cane*, a plant cultivated from time immemorial in India and China. It was unknown in Europe till after the conquests of Alexander the Great. The cultivation of the sugar cane was gradually introduced into Sicily and Spain, and, after the discovery of America, it was imported to the West Indian islands, where it has been cultivated to a great extent. Sugar has, in consequence, become a necessary of life among the modern nations of Enrope.

The juice is extracted by passing the cane between iron rollers, and immediately run into a flat copper cauldron, where it is mixed with a little lime, and heated to the temperature of 140°. A thick viscid scum collects on the surface, which is left unbroken, and the clear liquid drawn from below and introduced into a large boiler. Here it is boiled briskly, the scum, as it forms, being constantly removed. From this first boiler it is passed into a second, from that to a third and fourth, in each of which the boiling is continued. When sufficiently concentrated, it is poured into a large wooden vessel, called the *cooler*, where it crystallizes or *grains* as it cools. From the cooler it is taken and put into hogsheads, having a hole in the bottom, into which the stalk of a plantain leaf is thrust. Through these holes the *molasses* drain into a receiver. The sugar, thus cleared, is brought to this country under the name of *raw sugar*. It is refined by solution in water, clarified by bullock's blood, boiled down and poured into earthen cones, having a hole in the apex which is undermost. The base of the cone is covered with moist clay. From this the water slowly penetrates through the sugar, and carries off the impurities. In this state it is white, and is known by the name of *loaf sugar*.

From the experiments of Proust, it appears that sugar cane juice contains gluten, gum, extractive, a little malic acid, sulphate of lime, and two species of sugar. The object of the process is to remove all the substances, except the crystallizable sugar.

Sugar is a firm white substance, of an extremely sweet taste, but destitute of smell. It is but little altered by exposure to the atmosphere, though in damp air it is liable to become moist.

Cold water dissolves nearly its own weight of sugar; and boiling water dissolves any quantity whatever. The solution constitutes a thick, ropy, adhesive fluid, called syrup. When syrup is sufficiently concentrated, and kept in open vessels in a hot place, the sugar gradually crystallizes. The crystals are four or six-sided prisms, terminated by two-sided, and sometimes by three-sided summits.

The specific gravity of white sugar is 1.6065. It is not acted on by oxygen gas, by the simple combustibles, by azote, or by the metals. The alkaline earths combine with sugar, and form a compound which has a bitter and astringent taste. Sugar facilitates the solubility of lime and strontian in water; but barytes appears to act with more energy, and to occasion decomposition of sugar. The fixed alkalies combine with sugar, and form compounds similar to those formed by the alkaline earths.

The acids dissolve sugar, and the more powerful mineral acids decompose it. Nitric acid dissolves it with effervescence, converts one half of its carbon into carbonic acid, the residue assumes the form of water and oxalic acid. A quantity of malic acid is also evolved. 100 grains of sugar yield, by this treatment, 58 grains of oxalic acid. Sulphuric acid decomposes sugar, water and acetic acid are formed, and a great quantity of charcoal evolved.

Sugar dissolves in about 16 parts of boiling alcohol. If the solution be set aside, the sugar is gradually deposited in elegant crystals.

The hydrosulphurets, sulphurets, and phosphurets of alkalies and earths, seem to have the property of decomposing sugar, and of bringing it to a state not very different from that of gum.

When heat is applied to sugar, it melts, swells, becomes brownish black, emits air bubbles, and emits the smell of caromel. At a red heat it bursts into flames with a kind of explosion. When distilled, there comes over water; an acid liquid, called *pyromucous acid*, now known to be the acetic mixed with a little empyreumatic oil; an oil, and a bulky charcoal, remain in the retort. During the distillation a considerable quantity of carbonic acid and heavy inflammable air come over.

From the experiments of Lavoisier, compared with some of our own, it appears that sugar is composed of

64	oxygen
28	carbon
8	hydrogen
100	

According to the experiments of Thenard and Gay Lussac, the constituents of sugar are as follows:

Oxygen,	50.63
Carbon,	42.47
Hydrogen,	6.90
	100

It appears from the recent researches of chemists, that there exists various species of sugar, differing from each other in their properties. The most important of these are the following: Common sugar, liquid sugar, sugar of grapes, sugar of beet, manna.

Common sugar is the substance described in the preceding part of this chapter. It is obtained from the sugar cane. The properties of the sugar of the maple are not known to differ from those of common sugar.

Liquid sugar was first pointed out by Proust. It exists in a variety of fruits and vegetable juices. It does not crystallize, and can only be exhibited in a liquid state. It is more soluble in alcohol than common sugar. It exists in the juice of the sugar-cane, and constitutes no inconsiderable portion of *molasses*.

Sugar was first extracted from grapes by the Duc de Bullion. They often yield, according to Proust, from 30 to 40 per cent. of sugar. He extracted it by saturating the acids contained in the juice of grapes with potash, boiling it down to one half, and setting it aside. Several of the salts subsided. The juice was then mixed with blood, heated, scummed, filtered, and boiled down to a syrup. Crystals of raw sugar gradually form, which may be purified by repeating the process. This sugar is white, but inferior in consistence to common sugar. It is not so sweet, and resembles sugar from honey. Like it, the sugar of grapes crystallizes in sphericles. It is less soluble than common sugar, and does not go so far in sweetening liquids.

Sugar was first extracted from the beet by Margraaf. Many experiments were afterwards made upon the extraction, by Achard and other German philosophers, and attempts made to substitute the sugar of beet for common sugar, but it could not be obtained at a low enough price. It has a greater resemblance to common sugar than the sugar of grapes; but is distinguished by a certain nauseous bitter taste, owing perhaps to the presence of some foreign substance.

Manna is the produce of various trees, but is chiefly obtained from the *fraxinus ornus*, a species of *ash*, which grows abundantly in Sicily and Calabria. It partly exudes spontaneously during the summer months, and is partly obtained by incisions. The juice gradually concretes into a solid mass, or it is dried in the sun, or in stoves. Pure manna is very light, and appears to consist of a congeries of fine capillary crystals. Its taste is sweet, and it leaves a nauseous impression in the mouth. Hot alcohol dissolves it readily, and, on cooling, deposites about 5-8ths of the manna in the state of a fine light spongy crystalline mass, bearing some resemblance to camphor. This deposite may be considered as pure manna. It has an agreeable sweet taste, and instantly melts on the tongue, like snow in warm water. When dissolved in nitric acid, it yields oxalic acid. The saclactic appears also when the manna is impure. Manna does not undergo the vinous fermentation, and seems in consequence incapable of furnishing alcohol. Manna itself seems to be formed from uncrystallizable sugar by a species of fermentation.

The plants yielding sugar are very numerous. It seldom exudes spontaneously from vegetables, though this is sometimes the case.

Sect. III. *Of Sarcocoll.*

This substance, which has hitherto been confounded with the gum resins, though its properties are very different, exudes spontaneously from the *penæa sarcocolla*, a shrub said by botanical writers to be indigenous in the north-eastern parts of Africa. It may be obtained pure by solution in alcohol, filtration, and evaporation.

Pure sarcocoll has a brown colour, is semitransparent, and very like gum in appearance. Its specific gravity is 1.2684.

It has a sweet taste, but leaves an impression of bitterness. It dissolves readily both in water and alcohol. The solution is yellow. It does not crystallize. When heated, it softens, but does not melt. It emits a slight smell of caromel. When strongly heated it blackens, and assumes the consistence of tar, emitting a heavy white smoke, having an acrid odour. Nitric acid dissolves it, but does not convert it into tannin. From these properties, sarcocoll appears to be intermediate between gum and sugar.

Sect. IV. *Of Asparagin.*

We give this name to a substance discovered in the juice of *asparagus*, by Vauquelin and Robiquet. The juice was evaporated to the consistence of a syrup, and set aside. Crystals of asparagin formed in it spontaneously.

These crystals are white and transparent, and have the figure of rhomboidal prisms. The greater angle of the rhomboidal base is 130°.

Asparagin is hard and brittle. Its taste is cool, and slightly nauseous, so as to occasion a secretion of saliva.

It dissolves readily in hot water, but in cold water only sparingly. Alcohol does not dissolve it.

The aqueous solution does not affect vegetable blues. Neither infusion of nutgalls, acetate of lead, oxalate of ammonia, muriate of barytes, nor hydrosulphuret of potash, occasion any change in it. When triturated with potash, no ammonia is disengaged. The potash seems to render it more soluble in water.

When heated it swells, and emits penetrating vapours, affecting the eyes and nose, like the smoke of wood. It leaves a large portion of insipid charcoal, which, when incinerated, gives scarcely a trace of residue.

Nitric acid dissolves it with the evolution of nitrous gas. The solution has a yellow colour, and a bitter taste, like that of animal substances in the same acid. Lime disengages from it a considerable quantity of ammonia.

SECT. V. *Of Gum.*

There is a thick transparent tasteles fluid, which sometimes exudes from certain species of trees. It is very adhesive, and gradually hardens without losing its transparency, but easily softens again when moistened with water. This exudation is known by the name of gum. The gum most commonly used is that which exudes from different species of the *mimosa*, particularly the *nilotica*, and is known by the name of *gum arabic*.

Gum is usually obtained in small pieces like tears, moderately hard, and somewhat brittle while cold, so that it can be reduced by pounding to a fine powder. When pure it is colourless; but it has commonly a yellowish tinge, and it is not destitute of lustre. It has no smell. Its taste is insipid. Its specific gravity varies from 1.3161 to 1.4817.

It is not altered by exposure to the air, but the light of the sun makes it assume a white colour. Water dissolves it in large quantities. The solution, which is known by the name of *mucilage*, is thick and adhesive. It is often used as a paste, and to give stiffness and lustre to linen. When evaporated, the gum is obtained unaltered. Mucilage may be kept for years without undergoing putrefaction: at last, however, the odour of acetic acid becomes perceptible in it.

When gum is exposed to heat, it softens and swells, but does not melt; it emits air bubbles, blackens, and at last, when nearly reduced to charcoal, emits a low blue flame. A white ash remains, consisting chiefly of the carbonates of lime and potash.

Gum does not appear to be acted upon by oxygen gas, simple combustibles, azote, or the metals. The only metallic salts which occasion a precipitate when dropt into mucilage, are *nitrate of mercury*, and *acetate of lead*, both of which occasion a white precipitate. The superacetate of lead occasions no change. When oxymuriate of iron is poured into a strong mucilage, the whole is converted into a brown semitransparent jelly, which is not readily dissolved by water.

Neither the alkalies, alkaline earths, nor earthy salts, occasion any precipitate in mucilage; except silicated potash, which throws down a white flaky precipitate, even though very much diluted. The liquid remains transparent and colourless. Silicated potash is by far the most delicate test of gum that we have yet met with.

Liquid potash first converts gum into a substance not unlike curd, and then dissolves it. The solution is of a light amber colour, and transparent. When kept long, the gum falls again into the state of curd. Alcohol throws down the gum in white flakes, still soluble in water, but it retains the potash obstinately, and is much more friable than before. Lime water and ammonia likewise dissolve gum, and it may be afterwards separated little altered.

The vegetable acids dissolve gum without alteration, the strong acids decompose it. When thrown into sulphuric acid it blackens, and is decomposed. Charcoal is evolved, amounting to nearly one-third of the gum; some artificial tannin may be detected, and water and acetic acid are likewise formed. When gum is dissolved in strong muriatic acid, a brown solution is obtained, which becomes perfectly transparent when diluted with water, while at the same time some charry matter falls. If the solution be saturated with ammonia evaporated to dryness, and the residue digested in alcohol, the alcohol assumes a deep brown colour, and dissolves the whole, except a little sal ammoniac. The gum now bears some resemblance to sugar in its properties, at least when heated it melts, and gives out a very strong smell of caromel.

If nitric acid be slightly heated upon gum till it has dissolved it, and till a little nitrous gas has exhaled, the solution on cooling deposites saclactic acid. Malic acid is formed at the same time, and if the heat be continued, the gum is at last changed into oxalic acid.

Gum is insoluble in alcohol. It is precipitated from water by alcohol. It is insoluble also in ether and in oils; but when triturated with a little oil, it renders the oil miscible with water.

Gum readily combines with sugar by mixing together the solutions of both in water, and evaporating to dryness. Alcohol digested on the residuum, dissolves most of the sugar; a matter remains which still has a sweetish taste, and resembles the substance of which the nests of wasps are formed.

When gum is distilled in a retort, the products are water impregnated with acetic acid and oil, or *pyromucous acid*, as it was formerly called, a little empyreumatic oil, carbonic acid gas, and heavy inflammable air. There remains in the retort charcoal containing lime and phosphate of lime. Gum yields also traces of iron when its ashes are examined, but no fixed alkali or sulphur can be detected.

According to the analysis of Thenard and Gay Lussac, gum is composed of

Oxygen .	50.84
Carbon .	42.23
Hydrogen	6.93
	100.00

The species of gum at present known are numerous, and a more rigid examination of the vegetable kingdom will doubtless discover a still greater number. The most remarkable are gum arabic, gum Senegal, gum tragacanth, and cherry tree gums.

Gum arabic exudes from the *mimosa nilotica*. It is the species described in the preceding part of this Chapter.

Gum Senegal, brought from the island of that name, on the coast of Africa, often supplies the place of gum arabic in the shops. It is in larger masses than the arabic, and its colour is darker, but in other respects its properties are the same.

Gum tragacanth is the produce of the *astragalus tragacantha*, a thorny shrub which grows in Candia, and other islands of the Levant. It exudes about the end of June, from the stem and larger branches, and soon dries in the sun. It is in the state of whitish vermiform pieces, not nearly so transparent as gum arabic, and is exceedingly different from it in many of its properties. When put into water, it slowly imbibes a large quantity of the liquid, and forms a soft but not fluid mucilage. If the quantity of water be more than the gum can imbibe, the mucilage forms an irregular mass, which does not unite with the rest of the liquid. When tragacanth is treated with nitric acid, it yields abundance of saclactic acid, malic acid, and oxalic acid, but not the least trace of artificial tannin. When the mucilage of gum tragacanth is triturated in a mortar with water, it forms a homogeneous solution. This solution forms a precipitate with acetate and superacetate of lead and oxymuriate of tin. Nitrate of mercury throws down a' slight precipitate; but neither oxysulphate of iron, nor silicated potash produce any effect. These properties show it to differ very materially from gum arabic in its properties.

The *prunus avium*, the common cherry and plum-trees, and the almond and apricot, likewise yield a gum which exudes in great abundance from natural or artificial openings in the stem. It is of a reddish brown colour, in large masses; at first much softer than gum arabic, but, by keeping, it becomes very hard. When put into water it gradually swells, and is converted into a semi-transparent reddish brown jelly. Part of it dissolves, but a part of it remains in the state of jelly, and refuses to dissolve even when boiled in water for some time. The gum dissolved is not precipitated by alcohol nor by silicated potash. Acetate of lead produces no immediate effect, but on standing the whole becomes opake, and a precipitate at last subsides. Stannane causes the liquid to gelatinize immediately. The superacetate of lead and the nitrate of mercury produce no effect. When treated with nitric acid it yields a portion of saclactic acid. These properties show a marked difference between cherry-tree gum and the other species.

SECT. VI. *Of Mucus.*

The substances to which we give the name of *mucus*, have been hitherto considered as varieties of gum; but, from the recent experiments of Dr Bostock, it appears that their properties differ so much from those of gum, as to entitle them to a separate place as vegetable principles. They are very numerous, existing in the roots, leaves, and seeds of a great variety of plants. They scarcely ever separate spantaneously, but may be obtained artificially in a state of tolerable purity. Only a few of them have been examined. The rest are classed with these only from analogy.

Linseed yields mucus in a state of tolerable purity. When it is infused in ten times its weight of water, a fluid is obtained of the consistence of white of egg, which has the adhesive qualities of mucilage of gum arabic. When mixed with alcohol, the mucus is separated in white flocks, but the liquid does not become opake and milky, like mucilage of gum arabic when mixed with alcohol. Acetate of lead throws down a copious dense precipitate. Superacetate of lead and oxymuriate of tin render the liquid opake, and also throw down a precipitate. Nitrate of mercury occasions a very slight precipitate, while muriate of gold, oxysulphate of iron, and silicated potash produce no sensible effect whatever. No change is produced by the infusion of nutgalls.

Quince seeds and the root of the hyacinth yield a mucus with the same properties, with some slight shades of difference, owing probably to the presence of foreign bodies mixed with it. The roots of the hyacinth, vernal squill, white lily, comfrey, and salop, contain so much mucus, that, when dried, they may be substituted for gum arabic. The leaves of the *malva sylvestris*, many of the fuci, and a good many of the stringy lichens, contain likewise abundance of mucus. In short, it is one of the most common of the vegetable principles. Probably there are few plants which do not yield some portion of it.

SECT. VII. *Of Jelly.*

If we press out the juice of blackberries, currants, and many other fruits, and allow it to remain for some time in a state of rest, it coagulates into a tremulous soft substance, well known by the name of *jelly*. When it is washed with a small quantity of water, and then dried, we obtain it in a state approaching to purity.

It is nearly colourless, scarcely soluble in cold water, but very soluble in hot water, and, when the solution cools, it again coagulates into a jelly. When long boiled, it loses the property of gelatinizing, and becomes analogous to mucilage. When dried, it becomes transparent. When distilled, it yields the same products as gum. It seems very intimately connected with gum; but, as it has never been obtained in a state of complete purity, we are but imperfectly acquainted with its properties.

SECT. VIII. *Of Ulmin.*

We give this name to a substance lately examined by Klaproth. It exuded spontaneously from the trunk of a species of elm, called by him the *ulmus nigra*, and was sent to Klaproth from Palermo in 1802.*

Externally, it has a good deal of resemblance to gum. It is solid, hard, of a black colour, and has considerable lustre. Its powder is brown. It dissolves readily in the mouth, and has an insipid taste.

Water dissolves it. The solution has a brown colour. Though very strong, it is not in the least adhesive or ropy, nor does it answer as a paste. It is insoluble in alcohol and ether, and is partially precipitated from water by alcohol.

When a few drops of nitric acid are added to the aqueous solution of ulmin, it becomes gelatinous, loses its brown colour, and a light brown substance precipitates. This precipitate is soluble in alcohol, and explodes when moderately heated. Hence it is a compound of ulmin and nitric acid. Muriatic and sulphuric acids produce likewise yellowish brown precipitates, which are insoluble in water. Ulmin is likewise precipitated by sulphate of iron, muriate of tin, and acetate of lead, but not by nitrate of silver, nor solution of glue.

Ulmin when burnt emits little smoke or flame; it leaves a spongy but firm charcoal, which yields, when concentrated, a little carbonate of potash.

SECT. IX. *Of Inulin.*

We give this name to a substance discovered by Rose in the root of the *inula helenium*, or *elecampane*. When the root of this vegetable was boiled in water, the decoction, after standing some hours, deposites the *inulin* in the form of a white powder like starch.

It is insoluble in cold water. By trituration the inulin is uniformly diffused, and gives the liquid an opal appearance, but it soon falls down in the state of a white powder, leaving the liquid quite transparent.

It dissolves readily in hot water. One part of inulin in four parts of boiling water, formed a solution which passed readily through the filter. After some hours, the greater part of the inulin precipitates from the water in the form of a white powder.

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* There is no doubt that ulmin exudes from the common elm, nor that it is one of the substances originally described by Vauquelin as proceeding from the ulcers to which that tree is subject.

When the aqueous solution of inulin is mixed with an equal bulk of alcohol, no change takes place for some time; but the inulin soon separates and falls to the bottom in the state of a bulky white powder. A solution of gum arabic, when treated in this manner, remains milky for days without any precipitate falling.

When thrown upon burning coals, it melts as readily as sugar, and emits a thick white smoke, not unpleasantly pungent, and similar in odour to that of burning sugar. The residue, which is but small, sinks into the coal. Starch emits a similar smoke, but leaves a more bulky residue. When exposed to a red heat, inulin burns with a vivid flame, and leaves a very small coaly residue.

When distilled, inulin yields a brown acid liquid, having the smell of pyromucous acid, but not a trace of oil.

When inulin is treated with nitric acid, it yields malic and oxalic acids, or acetic acid if too much nitric acid be employed. But no saclactic acid is formed as happens with the gums, neither is any of the waxy matter separated, which makes its appearance when starch is digested in nitric acid.

Sect. X. *Of Starch.*

If a quantity of wheat flour be formed into a paste, and then held under a very small stream of water, kneading continually till the water runs off from it colourless, the flour, by this process, is divided into two distinct constituents. A tough substance, of a dirty white colour, called *gluten*, remains in the hand; the water is at first milky, but soon deposites a white powder, which is known by the name of *starch*.

The starch obtained by this process is not quite free from gluten. Hence it is not very white, and has not that crystallized appearance which distinguishes the starch of commerce. Manufacturers employ a more economical and more efficacious process. Wheat is steeped in water till it gives out a milky juice when squeezed, it is then put into coarse linen sacks, which are subjected to pressure in a vessel of water till the whole starchy matter is separated. The sack and its contents are then removed. The water containing the starch gradually ferments. Vinegar and alcohol are formed in it, partly, no doubt, at the expence of the starch. The vinegar thus formed dissolves all the impurities, and leaves nothing behind but the starch. It is poured off, and the starch being edulcorated with water, is dried with a moderate heat. During the drying, it usually splits into columnar masses, which have a considerable degree of regularity.

Starch was well known to the ancients. According to Pliny, the method of manufacturing it was discovered by the inhabitants of Chios.

Starch has a fine white colour, and is usually concreted in four-sided prisms. It has scarcely any smell, and very little taste. When kept dry, it continues for a long time uninjured, though exposed to the air.

It does not dissolve in cold water, but very soon falls to powder, and forms a kind of emulsion. It dissolves in boiling water, and forms a kind of jelly, which may be diffused through boiling water; but when the mixture is allowed to stand a sufficient time, the starch slowly precipitates to the bottom. The subsidence takes place even when 90 parts of water are employed to dissolve one of starch; but, in that case, at least a month elapses before the starch begins to precipitate. The solution is glutinous in proportion to the quantity of starch. Linen dipt into it and suddenly dried, acquires a considerable degree of stiffness. When the solution is evaporated to dryness, a brittle opake mass is obtained, differing in appearance from common starch, but exhibiting nearly the same properties with re-agents. Hence the apparent difference is probably owing to a portion of water remaining united to the boiled starch. When the solution of starch is left exposed to damp air, it soon loses its consistency, acquires an acid taste, and becomes mouldy on the surface.

Starch does not dissolve, nor even fall to powder in alcohol. Neither does it dissolve in ether.

Neither oxygen gas nor the simple combustibles have any marked action on starch. The metals and their oxides have little affinity for it. Acetate of lead throws it down from water, but the superacetate has no effect upon it. According to Dr Bostock, it is precipitated also by oxymuriate of tin; but in the trials made by the writer of this article, he obtained no precipitate with that salt in a decoction containing one-ninetieth of its weight of starch. No other metallic salt tried produced a precipitate in this dedoction.

Neither lime nor strontian water precipitate the decoction of starch; but barytes water throws down a copious white flaky precipitate. It is dissolved by muriatic acid, but appears again on standing, unless a considerable excess of acid be added. Neither muriate of barytes nor silicated potash occasion any precipitate in the decoction of starch.

When starch is triturated in a hot infusion of nutgalls, a complete solution is effected. This solution is transparent, and rather lighter coloured than the infusion of nutgalls employed. When this solution cools, it becomes opake, and a copious curdy precipitate falls. A heat of 120° re-dissolves this precipitate, and renders the solution transparent, but it is deposited again as the liquid cools. This property is characteristic of starch. The infusion of nutgalls throws it down from every solution, but the precipitate is re-dissolved by heating the liquid to 120°. The precipitate is a compound of tannin and starch, and is least soluble when composed of about three parts starch, and two parts tannin. It has a brownish yellow colour, is semi-transparent, has an astringent taste, and feels glutinous between the teeth like gum.

When potash is triturated with starch, and a little water added, the whole assumes, on standing, the appearance of a semi-transparent jelly. On adding water, an opal coloured solution is obtained, from which the starch is readily thrown down by an acid. When muriatic acid is employed, a peculiar aromatic odour is perceived. The decoction of starch is neither altered by potash, carbonate of potash, nor ammonia.

When starch is thrown into any of the mineral acids, at first no apparent change is visible; but, if an attempt is made to reduce the larger pieces, while in acids, to powder, they resist it, and feel exceedingly tough and adhesive. Sulphuric acid dissolves it slowly, and at the same time a smell of sulphuric acid is emitted, and such a quantity of charcoal evolved, that the vessel may be inverted without spilling any of the mixture. Diluted sulphuric acid dissolves starch when assisted by heat, and the starch may be again precipitated by means of alcohol.

Diluted nitric acid slowly dissolves starch; the acid acquires a green colour, and a small portion of white matter swims on the surface, on which the acid does not act. Alcohol throws down the starch from this solution. Concentrated nitric acid dissolves starch pretty rapidly, assuming a green colour, and emitting nitrous gas. The solution is never complete, nor do any crystals of oxalic acid appear unless heat be applied. In this respect starch differs from sugar, which yields oxalic acid even at the temperature of the atmosphere. When heat is applied to the solution of starch in nitric acid, both oxalic and malic acids are formed, but the undissolved substance still remains. When separated by filtration, and afterwards edulcorated, this substance has the appearance of a thick oil not unlike tallow; but it dissolves readily in alcohol. When distilled it yields acetic acid, and an oil having the smell and consistence of tallow.

Strong muriatic acid dissolves starch slowly and without effervescence. When the starch does not exceed one-twentieth of the acid, the solution is colourless and transparent; but if we continue to add starch, a brown colour appears, and the acid loses a portion of its fluidity. Its peculiar smell is destroyed, and replaced by the odour which may be perceived in corn mills. Acetic acid does not dissolve starch. The action of the other acids has not been tried.

Alcohol separates starch in part from its decoction. A solution of potash in alcohol occasions a copious white precipitate, which is re-dissolved on adding a sufficient quantity of water. A solution of sulphuret of potash in alcohol occasions a flaky precipitate in the decoction of starch. This precipitate has sometimes an orange colour.

When starch is thrown upon a hot iron, it melts, blackens, frothes, swells, and burns with a bright flame like sugar, emitting at the same time a great deal of smoke; but it does not explode, nor has it the caromel smell which distinguishes burning sugar. When distilled, it yields water, impregnated with an acid supposed to be the pyromucous, a little empyreumatic oil, and a great deal of carbonic acid and heavy inflammable air. The charcoal which it leaves burns easily when kindled in the open air, and leaves very little ashes. According to the experiments of Thenard and Gay Lussac, it is composed of

Oxygen	49.68
Carbon	43.55
Hydrogen	6.77
	100

Starch is contained in a great variety of vegetable substances; most commonly in their seeds or bulbous roots, but sometimes also in other parts. All the different species of corn contain a great proportion of it. There are obviously different varieties of starch, possessing distinct properties. But hitherto these varieties have not been examined with such attention as to enable us to give a detailed description of each.

Sect. XI. *Of Indigo.*

This valuable pigment, one of the capital manufactures of America, is obtained from the leaves of different species of plants: the *indigofera argentea* or *wild indigo*, the *indigofera disperma* or *Guatimala indigo*, and the *indigofera tinctoria* or *French indigo*, which yields the greatest quantity of indigo, and is therefore preferred by the planter, though its quality is said to be inferior to that of the indigo obtained from the two first species. In the West Indies the seeds are sown in March, in trenches about a foot asunder, and the plant comes into blossom, and is fit for cutting down in May. But in South America, six months elapse before it can be cut. In the West Indies, four cuttings are often obtained from the same plant in the course of a year; but in America, never more than two, and often only one. The produce constantly diminishes after the first cutting, so that it is necessary to renew the plants for seed every year.

The plants are cut down with sickles, and laid in strata in the *steeper* till it is about three parts full. This is a large cistern of wood or mason work about 16 feet square. Here they are pressed down with planks, and loaded to prevent them from swimming, and covered with water to the height of four or five inches. Here they ferment, and the utmost attention is required to the process. If they be allowed to remain too long, the pigment is spoiled; and if the water be drawn off too soon, much of the indigo is lost. The temperature of 80° is said to answer best. The water acquires a green colour, a smell resembling that of ammonia is exhaled, and bubbles of carbonic acid are emitted. When the fermentation has continued long enough, the liquor is let out into a second cistern placed lower than the first; this cistern is called the *battery*, and is commonly above 12 feet square, and four and a half deep. Here it is agitated for 15 or 20 minutes, by means of levers driven by machinery, till the flocculi beginning to separate give it a curdled appearance. A quantity of lime-water is now poured in, and the blue flocculi are allowed to subside. The water is then drawn off, and the pigment put to be drained in small linen bags, after which it is put into little square boxes, and allowed to dry in the shade.

Chevreul has shown, that the indigo exists in the plant chiefly in the state of a white matter, which becomes blue when it combines with oxygen. Indigo may be obtained also from other plants, the *nerium tinctorium*, for example, and the *isatis tinctoria*, or *woad*, a plant common enough in Britain. But the quantity obtained from this plant does not exceed one-tenth of what may be procured from the *indigofera*.

Indigo is a fine light friable substance of a deep blue colour. Its texture is very compact, and the shade of its surface varies according to the manner in which it has been prepared. The principal tints are copper, violet, and blue. The lightest indigo is the best; but it is always mixed with foreign substances, scarcely one half even of the best indigo of commerce consisting of the pure pigment. The following substances were extracted by Chevreul from 100 parts of Guatimala indigo:

Ammonia, a trace	
Disoxygenized indigo	12
Green matter	30
Bitter matter, a trace	
Red matter	6
Carbonate of lime	2
Oxide of iron and alumina . .	2
Silica	3
Pure indigo	45
	100

Pure indigo has neither taste nor smell. It is insoluble in water in its usual state, but disoxygenized indigo is soluble in that liquid, as are likewise some of the foreign bodies with which indigo is usually mixed. When heated, indigo sublimes in a purple smoke, and may be obtained unaltered crystallized in needles. This purple smoke is characteristic of indigo.

Neither oxygen nor the simple combustibles have any action on common indigo; but disoxygenised indigo readily combines with oxygen, and may be separated again from it without decomposition. In this respect it differs from almost all other vegetable substances, and approaches the properties of the simple combustibles and metals.

The fixed alkaline solutions have no effect upon indigo, except it be newly precipitated from a state of solution. In that case they dissolve it with facility. The solution has at first a green colour, which gradually disappears, and the natural colour of the indigo cannot be again restored. Hence we see that the alkalies, when concentrated, decompose indigo. Pure liquid ammonia acts in the same way. Even carbonate of ammonia dissolves precipitated indigo, and destroys its colour.

Lime-water has scarcely any effect upon indigo in its usual state, but it dissolves precipitated indigo The solution is at first green, but it becomes gradually yellow.

When diluted sulphuric acid is digested over indigo, it produces no effect except that of dissolving the impurities; but concentrated sulphuric acid dissolves it readily. One part of indigo, when mixed with eight parts of sulphuric acid, evolves heat, and is dissolved in 24 hours. The solution of indigo is well known in this country by the name of *liquid blue*. Bancroft calls it *sulphate of indigo*. While concentrated, it is opake and black; but when diluted, it assumes a fine deep blue colour, and its intensity is such, that a single drop of the concentrated sulphate is sufficient to give a blue colour to many pounds of water. Bergman ascertained the effect of different reagents on this solution with great precision. His experiments threw light not only on the properties of indigo, but upon the phenomena that take place when it is used as a dye-stuff.

From his experiments, it is obvious that all those substances which have a very strong affinity for oxygen give a green colour to indigo, and at last destroy it. Hence it is extremely probable, that indigo becomes green by giving out oxygen. Of course it owes its blue colour to that principle. This theory was first suggested by Mr Haussman, and still farther confirmed by Berthollet. Now it is only when green that it is in a state capable of being held in solution by lime, alkalies, &c. in which state it is applied as a dye to cloth. The cloth, when dipt into the vat containing it thus dissolved, combines with it, and the blue colour is restored by exposure to the atmosphere. It may be restored equally by plunging the cloth into oxymuriatic acid. Hence the restoration cannot but be ascribed to oxygen. Hence then the reason that sulphurous acid, the vegetable acids, sulphate of iron, give sulphate of indigo a green colour.

From these experiments, we see also that the colour of indigo is destroyed by the addition of those substances which part with oxygen very readily, as the black oxide of manganese. In that case the indigo is destroyed, for its colour cannot be again restored. When the sulphate of indigo is poured into boiling water, it affords a green-coloured solution; but with cold water a deep blue solution. What is called smoking sulphuric acid dissolves indigo much more readily than the pure acid, and evolves much more heat during the solution. Bucholz has shown, that by boiling sulphur in pure sulphuric acid, it acquires the property of dissolving indigo as readily as the smoking acid.

Nitric acid attacks indigo with great violence, with the evolution of abundance of heat and nitrous gas. When of the specific gravity 1.52, it even sets fire to indigo. When the acid is diluted, the action is still violent, unless the proportion of water be considerable. Mr Hatchett poured upon 100 grains of indigo an ounce of nitric acid, diluted with an equal quantity of water. The action was so rapid, that he found it necessary to add another ounce of water. When the effervescence had nearly subsided, the liquid was placed on a sand bath for some days, and evaporated to dryness. Water poured upon the residuum dissolved a considerable portion of it, and formed a beautiful deep yellow solution, of an intense bitter taste. This solution contains only a very small portion of oxalic acid; but with a solution of isinglass it forms a copious yellow insoluble precipitate, and of course contains a portion of artificial tannin. With ammonia crystals precipitate, consisting of *bitter principle* combined with ammonia.

When four parts of nitric acid are boiled upon one part of indigo, the pigment soon loses its colour, and is dissolved. The solution becomes yellow, and a thin layer of a resinous matter appears on the surface. If the process be now stopt, the resinous matter becomes thin by cooling. If this matter be removed, and the solution evaporated to the consistence of honey, redissolved in hot water and filtered, potash throws down yellow spicular crystals, consisting of *bitter principle* combined with potash. These crystals have the curious property of detonating with a purple light, when wrapt up in paper, and struck with a hammer; the resin, by treating it with fresh nitric acid, may be converted into the same bitter principle. If the process be stopt sooner than the point mentioned above, yellow crystals are obtained, which are more soluble in water, and which sublime in white needles, having all the properties of benzoic acid.

Muriatic acid does not act upon indigo in its common state, but it readily dissolves indigo precipitated from the sulphate, and forms a blue-coloured solution. The same phenomena are exhibited by the phosphoric, acetic, tartaric acids, and probably by all except the acid supporters.

Chlorine destroys the colour of indigo as readily as nitric acid.

Alcohol dissolves a small portion of indigo, but it gradually precipitates again, unless *red matter* be present, in which case the solution is permanent.

Indigo is not acted upon by ether or oils, at least if the experiments of Bergman be accurate.

When indigo is mixed with bran, woad, and other similar substances which readily undergo fermentation, it assumes a green colour during the fermentation, and is then easily dissolved by lime or potash. It is by this process that it is usually rendered proper for dyeing.

SECT. XII. *Of Gluten.*

If wheat-flour be kneaded into paste with a little water, it forms a tenacious, elastic, soft, ductile mass. This is to be washed cautiously, by kneading it under a small jet of water, till the water no longer carries off any thing, but runs off colourless; what remains behind is called *gluten*. It was discovered by Beccaria, an Italian philosopher, to whom we are indebted for the first analysis of wheat-flour.

Gluten, when thus obtained, is of a grey colour, exceedingly tenacious, ductile, and elastic, and may be extended to twenty times its original length. When very thin, it is of a whitish colour, and has a good deal of resemblance to animal tendon or membrane. Its smell is peculiar. It has scarce any taste, and does not lose its tenacity in the mouth.

When exposed to the air, it gradually dries; and when completely dry, it is pretty hard, brittle, slightly transparent, of a dark brown colour, and has some resemblance to *glue*.

Fresh gluten imbibes water, and retains a certain quantity of it with great obstinacy. To this water it owes its elasticity and tenacity. When boiled in water it loses both these properties.

When fresh gluten is macerated for a considerable time in cold water, the liquid becomes opake, and contains small films suspended, which do not soon subside. By repeated filtrations it becomes transparent; but it holds in solution gluten, which renders it frothy, and gives it the property of precipitating, when mixed with oxymuriatic acid or the infusion of nutgalls. Thus gluten is to a certain extent soluble in cold water. When the water is heated, the gluten separates in the state of yellow flakes.

When kept moist, it very soon begins to decompose, and to undergo a species of fermentation. It swells, and emits air-bubbles, which Proust has ascertained to consist of hydrogen and carbonic acid gases. It emits also a very offensive odour, similar to what is emitted by putrefying animal bodies. Cadet kept gluten in a vessel for a week in a damp room. Its surface became covered with byssi, the fermentation just mentioned had commenced, and the odour was distinctly acid. In 24 days, on removing the upper crust, the gluten was found converted into a kind of paste, of a greyish-white colour, not unlike bird-lime. In that state he gave it the name of *fermented gluten*. If the gluten be still left to itself, it gradually acquires the smell and the taste of *cheese*. This curious fact was first ascertained by Rouelle junior. In that state it is full of holes, and contains the very same juices which distinguish some kinds of cheese. Proust ascertained that it contains ammonia and vinegar; bodies which Vauquelin detected in cheese; and ammonia robs both equally of their smell and flavour.

Fresh gluten does not sensibly dissolve in alcohol, which even throws down fresh gluten from water; yet in certain cases this liquid forms a solution of gluten in very small proportion.

When the *fermented gluten* of Cadet is triturated with a little alcohol into a mucilage, and then mixed with a sufficient quantity of that liquid, a portion of it is dissolved. This solution constitutes an excellent varnish, possessed of considerable elasticity. It may be spread over paper or wood; and when dry resists other bodies, as well as most varnishes. In this state, too, it may be employed to cement china; and triturated with paints, especially vegetable colours, it forms a very good ground. When this solution is mixed with a sufficient quantity of time, it forms a very good lute; and bits of linen dipt in it adhere very strongly to other bodies.

Ether does not sensibly dissolve gluten.

Acids act upon gluten differently, according to the peculiar properties of each.

Concentrated acetic acid dissolves it readily in considerable quantity, and without altering its nature. The solution is muddy, but permanent; and the gluten may be thrown down by means of alkalies. This acid dissolves the fermented gluten of Cadet; and the solution may be substituted for the solution in alcohol as a varnish; but it does not answer to mix it with colours.

Concentrated sulphuric acid renders it violet coloured, and at last black; inflammable air escapes, and charcoal, water, and a portion of ammonia, are formed. When nitric acid is poured on it, and heat applied, there is a quantity of azotic gas emitted; and by continuing the heat, some little oxalic acid is formed, and likewise malic acid, while a number of yellow-coloured oily flakes make their appearance in the solution.

Muriatic acid dissolves gluten with facility when its action is assisted by heat. When gluten is placed in oxymuriatic acid, it softens, and seems to dissolve, but soon coagulates again into yellow-coloured flakes, which become transparent and greenish-coloured by drying. When heated, they exhale oxymuriatic acid, and assume the appearance of common gluten. This acid has the property of precipitating gluten from water in the state of yellowish-white flakes.

Alkalies dissolve gluten when they are assisted by heat. The solution is never perfetly transparent. Acids precipitate the gluten from alkalies, but it is destitute of its elasticity. Alkalies, when much concentrated, form with it a kind of soap, converting it into oil and ammonia; which last is dissipated during the trituration.

Gluten is precipitated from water, and from some of its other solutions, by the infusion of nutgalls. The colour of the precipitate is usually yellowish-brown, and it does not dissolve though the solution be heated.

When moist gluten is suddenly dried, it swells amazingly. Dry gluten, when exposed to heat, cracks, swells, melts, blackens, exhales a fetid odour, and burns precisely like feathers or horn. When distilled, there comes over water impregnated with ammonia and an empyreumatic oil; the charcoal which remains is with difficulty reduced to ashes.

Sect. III. *Of Albumen.*

Albumen is the term by which chemists have agreed to denote the *white of egg*, and all glary tasteless substances which, like it, have the property of coagulating into a white, opaque, tough, solid substance, when heated a little under the boiling point. This substance forms a constituent of many of the fluids of animal bodies; and when coagulated, it constitutes also an important part of their solids. Substances analogous to it had been noticed by chemists in the vegetable kingdom. Scheele affirmed, as early as 1780, that the greater number of plants contained a substance analogous to curd. Fourcroy, about the year 1790, announced the existence of albumen in a variety of plants; but Proust has since shewn, that the substance which he took for albumen, and which had been already examined by Rouelle, was not possessed of the properties which characterise that animal matter. But Vauquelin has lately discovered albumen in abundance in the juice of the papaw tree; so that its existence as a vegetable principle cannot be disputed.

The *papaw tree*, the *carica papaya* of botanists, grows in Peru, &c. and in the Isle of France, where the milky juice that exudes from it is said to be employed with efficacy against the *Guinea worm*. Two specimens of this juice were brought from that island to Paris by Charpentier de Cossigny. In the one, the juice had been evaporated to dryness, and was in the state of an extract; in the other, the juice was preserved by being mixed with an equal bulk of rum. Both were subjected to a chemical analysis by Vauquelin. The first was of a yellowish-white colour, and semitransparent. Its taste was sweetish. It had no smell, and was pretty solid; but attracted moisture when kept in a damp place. The second was reddish-brown, and had the smell and taste of boiled beef. When the first specimen was macerated in cold water, the greatest part of it dissolved. The solution frothed with soap. The addition of nitric acid coagulated it, and rendered it white; and when boiled, it threw down abundance of white flakes. These flakes were coagulated albumen.

Other specimens of this juice, both in the liquid and dried state, have been examined more recently by Vauquelin, and likewise by Cadet.

The essential characters of albumen are the following:

In its natural state it is soluble in water, and forms a glary limpid liquid, having very little taste; which may be employed as a paste, and which forms a very shining varnish.

The solution is coagulated by acids, pretty much in the same way as milk is coagulated by the same reagents.

When not too much diluted, it is coagulated also when heated to the temperature of 176°.

Albumen dissolved in water is precipitated in the state of brown flakes by the infusion of tan.

The solution is equally coagulated when mixed with alcohol.

Albumen is precipitated from water in the state of white powder by the salts of most of the white metals; such as silver, mercury, lead, tin, &c.

The juice of the papaw possessed all these properties. It therefore contained albumen. In few other vegetable productions has this substance been yet found in such abundance, or in a state in which its properties were so decidedly characteristic; but the resemblance between the curd of milk and albumen is very close, as we shall see afterwards. Now, Proust has ascertained that *almonds*, and other similar kernels from which *emulsions* are made, contain a substance which has the properties of curd.

Albumen, when burnt, emits ammonia; and when treated with nitric acid, yields azotic gas. It evidently, then, contains azote. But as it is more properly an animal than a vegetable substance, we shall defer giving any farther account of its properties till we come to treat of animal bodies.

SECT. XIV. *Of Fibrin.*

That peculiar substance which constitutes the fibrous part of the muscles of animals, has been called *fibrin* by chemists. A substance resembling it, as it exists in the blood, has been detected by Vauquelin in the juice of the papaw tree; the same juice which contained albumen in such plenty. Fibrin, then, must be ranked among vegetable substances.

When the juice of the papaw is treated with water, the greatest part dissolves; but there remains a substance insoluble, which has a greasy appearance. It softens in the air, and becomes viscid, brown, and semitransparent. When thrown on burning coals, it melted, let drops of grease exude, emitted the noise of meat roasting, and produced a smoke which had the odour of fat volatilized. It left behind it no residue. This substance was the *fibrin*. The resemblance between the juice of the papaw and animal matter is so close, that one would be tempted to suspect some imposition, were not the evidence that it is really the juice of a tree quite unexceptionable.

The properties of fibrin are the following:

1. It is tasteless, fibrous, elastic, and resembles gluten.
2. It is insoluble in water and in alcohol.
3. It is not dissolved by diluted alkalies.
4. But acids dissolve it without difficulty.
5. With nitric acid it gives out much azotic gas.
6. When distilled it yields much carbonate of ammonia and oil.
7. It soon putrefies when kept moist, becomes green, but does not acquire any resemblance to cheese.

SECT. XV. *Of the Bitter Principle.*

Many vegetable substances have an intensely bitter taste, and on that account are employed in medicine, by brewers, &c. This is the case with the wood of the *quassia amara* and *excelsa*, the common *quassia* of the shops; with the roots of the *gentiana lutea*, common *gentian*; the leaves of the *humulus lupulus*, or *hop*; the bark and wood of the *spartium scoparium*, or common broom; the flowers and leaves of the *anthemis nobilis*, or *chamomile*; and many other substances. Some of these bodies owe their bitter taste to the presence of a peculiar vegetable substance differing from every other, which may be distinguished by the name of the *bitter principle*.

No chemical examination of this substance has been hitherto published; nor, indeed, are we in possession of any method of separating it from other bodies, or of ascertaining its presence. At the same time, it cannot be doubted that it possesses peculiar characters; and its action on the animal economy renders it an object of importance.

I. When water is digested over *quassia* for some time, it acquires an intensely bitter taste, and a yellow colour, but no smell. When water thus impregnated is evaporated to dryness in a low heat, it leaves a brownish-yellow substance, which retains a certain degree of transparency. It continues ductile for some time, but at last becomes brittle. This substance we shall consider as the bitter principle in a state of purity. If it contains any foreign body, it must be in a very minute proportion. This substance was found by the writer of this article to possess the following properties:

1. Its taste is intensely bitter. Colour brownish-yellow.
2. When heated, it softens, and swells, and blackens; then burns away without flaming much, and leaves a small quantity of ashes.
3. Very soluble in water and alcohol.
4. Does not alter the colour of infusion of litmus.
5. Lime-water, barytes-water, and strontian-water, occasion no precipitate. Neither is any precipitate thrown down by silicated potash, aluminated potash, or sulphate of magnesia.
6. The alkalies occasion no change in the diluted solution of the bitter principle.
7. Oxalate of ammonia occasions no precipitate.
8. Nitrate of silver renders the solution muddy, and a

very soft flaky yellow precipitate falls slowly to the bottom.

9. Neither corrosive sublimate nor nitrate of mercury occasion any precipitate.

10. Nitrate of copper, and the ammonial solution of copper, produce no change; but muriate of copper gives the white precipitate, which falls when this liquid salt is dropt into water.

11. Sulphate and oxymuriate of iron occasion no change.

12. Muriate of tin renders the solution muddy, but occasions no precipitate, unless the solution be concentrated; in that case a copious precipitate falls.

13. Acetite of lead occasions a very copious white precipitate; but the nitrate of lead produces no change.

14. Muriate of zinc occasions no change.

15. Nitrate of bismuth produces no change, though when the salt is dropt into pure water a copious white precipitate appears.

16. Tartar emetic produces no change; but when the muriate of antimony is used, the white precipitate appears, which always falls when this salt is dropt into pure water.

17. Muriate and arseniate of cobalt occasion no change.

18. Arseniate of potash produces no effect.

19. Tincture of nutgalls, infusion of nutgalls, gallic acid, occasion no effect.

These properties are sufficient to convince us that the bitter principle is a substance differing considerably from all the other vegetable principles. The little effect of the different re-agents is remarkable. Nitrate of silver and acetate of lead are the only two bodies which throw it down. This precipitation cannot be ascribed to the presence of muriatic acid; for if muriatic acid were present, nitrate of lead would also be thrown down.

II. Besides this purest species of bitter principle, it is probable that several others exist in the vegetable kingdom, gradually approaching by their qualities to the nature of *artificial tannin*. The second species is distinguished from the preceding, by the property which it has of striking a green colour with iron, and of precipitating that metal from concentrated solutions. Mr Chenevix separated a portion of it from coffee by the following process: He digested unburnt coffee in water, and filtered the liquid. It was then treated with muriate of tin. The precipitate was edulcorated, mixed with water, and treated with sulphureted hydrogen gas. The tin was thus precipitated, and the substance with which it had been combined was dissolved by the water. The liquid was then evaporated to dryness. The substance thus obtained possessed the following properties:

1. Semitransparent like horn, and of a yellow colour.

2. When exposed to the air it does not attract moisture.

3. Soluble in water and in alcohol. The solution in water is semitransparent, and has a pleasant bitter taste. When the alkaline solutions are dropt into it, the colour becomes garnet red.

4. It is not precipitated from water by the alkaline carbonates. Sulphuric acid renders the solution brown, but produces no further change. Neither muriatic acid, nor phosphoric acid, nor the vegetable acids, produce any change on this solution.

5. The muriates of gold, platinum, and copper, occasion no change.

6. With solutions of iron it forms a fine green coloured liquid; and when concentrated, iron throws down a green-coloured precipitate. Indeed, it is almost as delicate a test of iron as tan and gallic acid.

7. Muriate of tin throws down a copious yellow precipitate. This precipitate, and that by iron, are soluble in all acids, but they lose their colour.

8. Neither lime nor strontian water occasion any precipitate in the aqueous solutions of this substance; but barytes water occasions a brown precipitate.

9. Gelatine occasions no precipitate.

III. The third species may be distinguished by the name of *artificial bitter principle*, as it has been formed by the action of nitric acid on various vegetable and animal substances. It was first obtained by Haussman, while examining indigo, but he mistook its nature. Welther afterwards formed it by digesting silk in nitric acid, ascertained its properties, and gave it the name of *yellow bitter principle;* he is therefore to be considered as the real discoverer. Bartholdi afterwards procured it by treating the *white* willow with nitric acid. Mr Hatchett lately obtained it during his experiments on artificial tannin, by treating indigo with nitric acid; and about the same time Fourcroy and Vauquelin procured it by the same means, and examined its properties in detail. This substance possesses the following properties:

Its colour is a deep yellow, its taste intensely bitter. It is soluble both in water and alcohol, and has the property of dyeing silk, woollen cloth, and cotton, of a durable yellow colour. It crystallizes in elongated plates, and possesses many of the characters of an acid, combining readily with alkaline substances, and forming crystallizable salts. When potash is dropt into a concentrated solution of it, small yellow prismatic crystals are gradually deposited, consisting of bitter principle combined with potash. These crystals were examined by Welther, but it was Fourcroy and Vauquelin that ascertained their composition. They have a bitter taste, are not altered by exposure to the air, are less soluble than pure bitter principle. When thrown upon hot charcoal they burn like gunpowder, and detonate very loudly when struck upon an anvil, emitting a purple light. Ammonia dropt into the solution of bitter principle deepens its colour, and occasions a copious deposition of fine yellow spicular crystals. These are a combination of bitter principle and ammonia.

IV. Artificial tannin itself may be considered as approaching the bitter principle in many of its properties. Its taste is always intensely bitter, and the colour of the precipitates which it throws down from the metals, is similar to what takes place when artificial bitter principle is present. It is indeed possible, that the bitter taste may be owing not to the tannin, but to a portion of artificial bitter principle, which may be always formed along with the tannin; but this has not been ascertained. It is well known, that the bitter taste very easily overpowers and conceals all other tastes.

SECT. XVI. *Of Tannin.*

Notwithstanding the numerous experiments made upon the infusion of nutgalls, we are not in possession of a process capable of furnishing tannin in a state of purity. Hence the obscurity which still hangs over its characters. The properties of this substance, as far as known, and the different methods of procuring it hitherto proposed by chemists, have been detailed in a preceding part of this article.

Like most other vegetable substances, it seems to be susceptible of different modifications. The following are the different species of tannin which have been hitherto noticed:

1. Tannin from nutgalls. This is the common species described in this article under the name of tannin. It precipitates iron black, and forms a firm insoluble brown precipitate with glue. The bark of oak, and most other astringent trees in this country, are supposed at present to contain this species of tannin.

2. The tannin which constitutes so large a proportion of catechu forms the second species. Its peculiar nature was first observed by Proust. It was afterwards more particularly examined by Mr Davy. It forms with iron an olive coloured precipitate.

3. The tannin of *kino* constitutes a third species. This substance is obtained from different vegetables. It was originally imported, as is supposed, from Africa; but at present the common kino of the shops is, according to Dr Duncan, an extract from the *coccoloba urifera*, or *sea-side grape*, and is brought chiefly from Jamaica. But the finest kino is the product of different species of *eucalyptus*, particularly the *resinifera*, or brown gum-tree of Botany Bay. It is an astringent substance of a dark red colour, and very brittle. It dissolves better in alcohol than water. The solution in the latter liquid is muddy; in the former transparent, and a fine crimson if sufficiently diluted. It throws down gelatine of a rose colour, and forms with salts of iron a deep green precipitate, not altered by exposure to the air.

4. The fourth variety of tannin is contained in *sumach*. This is a powder obtained by drying and grinding the shoots of the *rhus coriaria*; a shrub cultivated in the southern parts of Europe. The tan, which it contains in abundance, yields a precipitate with gelatine, which subsides very slowly, and remains in the state of a white magma without consistence.

5. The fifth variety, according to Proust, is to be found in the wood of the *morus tinctoria*, or *old fustic*, as the British dyers term it. This wood gives out an extract both to alcohol and water, which yields a precipitate with gelatine. A solution of common salt is sufficient to throw it down.

SECT. XVII. *Of the Extractive Principle.*

The word *extract* was at first applied to all those substances which were extracted from plants by means of water, and which remained behind in the state of a dry mass when the water was evaporated; consequently it included gum, jelly, and several other bodies. But, of late, it has been confined by many to a substance which exists in many plants, and which may be obtained nearly in a state of purity, according to Hermbstadt, by infusing *saffron* in water for some time, filtrating the infusion, and evaporating it to dryness. But as the word *extract* occurs even in modern authors in its original sense, we shall rather denote this substance by the phrase *extractive principle*, to prevent ambiguity.

The difficulty of obtaining the extractive principle in a separate state, and the facility with which it alters its nature, have hitherto prevented chemists from examining it with that attention to which it is entitled. It was first particularly attended to by Rouelle; but it is to Fourcroy and Vauquelin that we are chiefly indebted for ascertaining its characters. The dissertation of Vauquelin, in the *Journal de Pharmacie*, is by far the best account of extractive matter which has hitherto appeared. Many valuable facts and curious observations were published by Hermbstadt, also, in his dissertation on *extract*. But, unfortunately, the term has not been always taken by chemists in the same acceptation. Parmentier has lately published a dissertation on the *extracts* of vegetables, taken in the loose and general sense of the word, which contains much information.

The extractive principle possesses the following properties:

Soluble in water, and the solution is always coloured. When the water is slowly evaporated, the extractive matter is obtained in a solid state and transparent; but when the evaporation is rapid the matter is opake.

The taste of extractive is always strong; but it is very different according to the plant from which it is obtained.

Soluble in alcohol, but insoluble in ether.

By repeated solutions and evaporations, the extractive matter acquires a deeper colour, and becomes insoluble in water. This change is considered as the consequence of the absorption of the oxygen of the atmosphere, for which the extractive principle has a strong affinity. But if the solution be left to itself, exposed to the atmosphere, the extract is totally destroyed in consequence of a kind of putrefaction which speedily commences.

When oxymuriatic acid is poured into a solution containing extractive, a very copious dark yellow precipitate is thrown down, and the liquid retains but a light lemon colour. These flakes are the oxygenized *extractive*. It is now insoluble in water; but hot alcohol still dissolves it.

The extractive principle unites with alumina, and forms with it an insoluble compound. Accordingly, if sulphate, or muriate of alumina, be mixed with a solution of extractive, a flaky insoluble precipitate appears, at least when the liquid is boiled; but if an excess of acid be present, the precipitate does not always appear.

It is precipitated from water by concentrated sulphuric acid, muriatic acid, and probably by several other acids. When the experiment is made with sulphuric acid, the fumes of vinegar generally become sensible.

Alkalies readily unite with extractive, and form compounds which are insoluble in water.

The greater number of metallic oxides form insoluble compounds with extractive. Hence, many of them, when thrown into its solution, are capable of separating it from water. Hence also, the metallic salts mostly precipitate extractive. Muriate of tin possesses this property in an eminent degree. It throws down a brown powder perfectly insoluble, composed of the oxide of tin and vegetable matter.

If wool, cotton, or thread, be impregnated with alum, and then plunged into a solution of extractive, they are dyed of a fawn colour, and the liquid loses much of its extractive matter. This colour is permanent. The same effect is produced, if muriate of tin be employed instead of alum. This effect is still more complete, if the cloth be soaked in oxymuriatic acid, and then dipt into the infusion of extractive. Hence we see that the extractive matter requires no other mordant than oxygen, to fix it on cloth.

When distilled, extractive yields an acid liquid impregnated with ammonia.

It cannot be doubted, that there are many different species of extractive matter; though the difficulty of obtaining each separately has prevented chemists from ascertaining its nature with precision. Extracts are usually obtained by treating the vegetable substance from which they are to be procured with water, and then evaporating the watery solution slowly to dryness. All extracts obtained by this method have an acid taste, and redden the infusion of litmus. They all yield a precipitate while liquid, if they are mixed with ammonia. This precipitate is a compound of lime and insoluble extractive. Lime always causes them to exhale the odour of ammonia. It has been ascertained, that the extractive principle is more abundant in plants that have grown to maturity than in young plants.

Sect. XVIII. *Of the Narcotic Principle.*

It has been long known that the milky juices which exude from certain plants, as the poppy, lettuce, &c. and the infusions of others, as of the leaves of the *digitalis purpurea*, have the property of exciting sleep, or, if taken in large enough dozes, of inducing a state resembling apoplexy, and terminating in death. How far these plants owe these properties to certain common principles which they possess is not known; though it is exceedingly probable that they do. But as a *peculiar substance* has been detected in *opium*, the most noted of the narcotic preparations which possesses narcotic properties in perfection, we are warranted, till further experiments elucidate the subject, to consider it as the *narcotic principle*, or at least as one species of the substances belonging to this genus.

Opium is obtained from the *papaver album*, or white poppy, a plant which is cultivated in great abundance in India and the East. The poppies are planted in a fertile soil and well watered. After the flowering is over, and the seed capsules have attained nearly their full size, a longitudinal incision is made in them about sun-set, for three or four evenings in succession. From these incisions there flows a milky juice, which soon concretes, and is scraped off the plant and wrought into cakes. In this state it is brought to Europe.

Opium, thus prepared, is a tough brown substance, has a peculiar smell, and a nauseous bitter acrid taste. It is a very compound substance, containing sulphate of lime, sulphate of potash, an oil, a resinous body, an extractive matter, gluten, mucilage, &c. besides the peculiar narcotic principle, to which, probably, it owes its virtues as a narcotic.

When water is digested upon opium, a considerable portion of it is dissolved, the water taking up several of its constituents. When this solution is evaporated to the consistence of a syrup, a gritty precipitate begins to appear, which is considerably increased by diluting the liquid with water. It consists chiefly of three ingredients; namely, resin, oxygenized extractive, and the peculiar narcotic principle, which is crystallized. When alcohol is digested on this precipitate, the resin and narcotic substance are taken up, while the oxygenized extractive remains behind. The narcotic principle falls down in crystals as the solution cools, still however coloured with resin. But it may be obtained tolerably pure by repeated solutions and crystallizations.

Water is incapable of dissolving the whole of opium. What remains behind still contains a considerable portion of narcotic principle. When alcohol is digested on this residuum, it acquires a deep red colour; and deposites, on cooling, crystals of narcotic principle, coloured by resin, which may be purified by repeated crystallizations. The narcotic principle obtained by either of these methods possesses the following properties.

Its colour is white. It crystallizes in rectangular prisms with rhomboidal bases. It has neither taste nor smell.

It is insoluble in cold water, soluble in about 400 parts of boiling water, but precipitates again as the solution cools. The solution in boiling water does not affect vegetable blues.

It is soluble in 24 parts of boiling alcohol and 100 parts of cold alcohol. When water is mixed with the solution, the narcotic principle precipitates in the state of a white powder.

Hot ether dissolves it, but lets it fall on cooling.

When heated in a spoon, it melts like wax. When distilled it froths and emits white vapours, which condense into a yellow oil. Some water and carbonate of ammonia pass into the receiver; and at last carbonic acid gas, ammonia, and carbureted hydrogen gas, are disengaged. There remains a bulky coal, which yields traces of potash. The oil obtained by this process is viscid, and has a peculiar aromatic smell and acrid taste.

It is very soluble in all acids. Alkalies throw it down from these solutions in the state of a white powder.

Alkalies render it rather more soluble in water. When they are saturated with acids, the narcotic principle falls down in the state of a white powder, which is redissolved by adding an excess of acid.

Volatile oils, while hot, dissolve it; but, on cooling, they let it fall in an oleaginous state at first, but it gradually crystallizes.

When treated with nitric acid, it becomes red and dissolves; much oxalic acid is formed, and a bitter substance remains behind.

When potash is added to the aqueous solution of opium, the narcotic principle is thrown down; but it retains a portion of the potash.

Its solubility in water and alcohol, when immediately extracted from opium, seems to be owing to the presence of *resin* and *extractive matter*, both of which render it soluble.

It possesses the properties of opium in perfection. Dérosne tried it upon several dogs, and found it more powerful than opium. Its bad effects were counteracted by causing the animals to swallow vinegar. This substance is known to be of equal service in counteracting the effects of opium. Dérosne supposes that the efficacy of vinegar may be owing to the readiness with which it dissolves the narcotic principle.

Sect. XIX. *Of Oils.*

There are two species of oils; namely, *fixed* and *volatile;* both of which are found abundantly in plants.

1. Fixed oil is only found in the seeds of plants, and is almost entirely confined to those which have two cotyledons; as lintseed, almonds, beech root, poppy seed, rape seed, &c. Sometimes, though rarely, it is found in the pulp which surrounds the stone of certain fruits. This is the case with the olive, which yields the most abundant and most valuable species of fixed oil. The bicotyledonous seeds, besides oil, contain also a mucilaginous substance; and they have all the character of forming, when bruised in water, a milky liquid, known by the name of *emulsion*.

The following is a list of the plants which yield the fixed oils which usually occur in commerce.

1. Linum usitatissimum et perenne	Linseed oil
2. Corylus avellana	Nut oil
3. Juglans regia	
4. Papaver somniferum	Poppy oil
5. Cannabis sativa	Hemp oil
6. Sesamum orientale	Oil of Sesamum
7. Olea Europea	Olive oil
8. Amygdalus communis	Almond oil
9. Guilandina Mohringa	Oil of behen
10. Cucurbita pepo et melopepo	Cucumber oil
11. Fagus sylvatica	Beech oil
12. Sinapis nigra et arvensis	Oil of mustard
13. Helianthus annuus et perennis	Oil of sunflower
14. Brassica napus et campestris	Rape seed oil.
15. Ricinus communis	Castor oil
16. Nicotiana tabacum et rustica	Tobacco seed oil
17. Prunus domestica	Plum kernel oil
18. Vitis vinifera	Grape seed oil
19. Theobroma cacao	Butter of cacao
20. Laurus nobilis	Laurel oil
21. Arachis hypogæa	Ground nut oil

2. Volatile oils are found in every part of plants except the cotyledons of the seeds, where they never occur. The root, the stem, the leaves, the flower, the rind or pulp of the fruit of a variety of plants, are loaded with volatile oils, from which they are extracted by expression or by distillation. The number of these oils is so great that it baffles all description. Almost every plant which is distinguished by a peculiar odour contains a volatile oil, to which it is indebted for that odour.

The following Table contains a pretty copious list of plants which yield volatile oils. The part of the plant from which it is extracted, and the English name of the oil, are added in separate columns.

Plants.	*Parts.*	*Oil of*	*Colour.*
1. Artemisia absynthium	Leaves	Wormwood	Green
2. Acorus calamus	Root	Sweet flag	Yellow
3. Myrtus pimenta	Fruit	Jamaica pep.‡	Yellow
4. Anethum graveolens	Seeds	Dill	Yellow
5. Angelica archangelica	Root	Angelica	
6. Pimpinella	Seeds	Anise	White
7. Illicium anisatum	Seeds	Stellat. anise	Brown
8. Artemisia vulgaris	Leaves	Mugwort	
9. Citrus aurantium	Rind of the fruit	Bergamotte	Yellow
10. Melaleuca leucadendron	Leaves	Cajeput	Green
11 Eugenia caryophyllata	Capsules	Cloves‡	Yellow
12. Carum carvi	Seeds	Caraways	Yellow
13. Amomum cardamomum	Seeds	Card. seeds	Yellow
14 Carlina acaulis	Roots		White
15. Scandix chærefolium	Leaves	Chervil	Sulph. yel.
16. Matricaria chamomilla	Petals	Chamomile	Blue
17. Laurus cinnamomum	Bark	Cinnamon‡	Yellow
18. Citrus medica	Rind of the fruit	Lemons	Yellow
19. Cochlearia officinalis	Leaves	Scurvy grass	Yellow
20 Copaifera officinalis	Extract	Copaiba	White
21. Coriandrum sativum	Seeds	Coriand. seed	White
22. Crocus sativus	Pistils	Saffron‡	Yellow
23. Piper cubeba	Seeds	Cubeb peb	Yellow
24. Laurus culilaban	Bark	Culilaban	Br. yel.
25 Cuminum cyminum	Seeds	Cummi	Yellow
26 Inula helenium	Roots	Elecampane	White
27 Anethum fœniculum	Seeds	Fennel	White
28. Croton clutheria	Bark	Cascarilla	Yellow
29. Maranta galanga	Roots	Galanga	Yellow
30. Hyssopus officinalis	Leaves	Hyssop	Yellow
31. Juniperus communis	Seeds	Juniper	Green
32. Lavendula spica	Flowers	Lavender	Yellow
33. Laurus nobilis	Berries	Laurel	Brownish
34. Prunus laurocerasus	Leaves	Laurocerast	
35. Levisticum ligusticum	Roots	Lovage	Yellow
36. Myristica moschata	Seeds	Mace	Yellow
37. Origanum majorana	Leaves	Majoram	Yellow
38. Pistacia lentiscus	Resin	Mastich	Yellow
39. Matricaria parthenium	Plant	Motherwort	Blue
40. Melissa officinalis	Leaves	Balm	White
41 Mentha crispa	Leaves		White
42. ——— piperitis	Leaves	Peppermint	Yellow
43. Achillea millefolium	Flowers	Millefoil	Blue and green
44. Citrus aurantium	Petals	Neroli	Orange
45. Origanum creticum	Flowers	Spanish hop	Brown
46. Apium petroselinum	Roots	Parsley	Yellow
47. Pinus sylvestris et abies	Wood and resin	Turpentine	Colourless
48. Piper nigrum	Seeds	Pepper	Yellow
49. Rosmarinus officinalis	Plant	Rosemary	Colourless
50. Mentha pulegium	Flowers	Pennyroyal	Yellow
51. Genista canariensis	Root	Rhodium	Yellow
52. Rosa centifolia	Petals	Roses	Colourless
53. Ruta graveolens	Leaves	Rue	Yellow
54. Juniperus sabina	Leaves	Savine	Yellow
55. Salvia officinalis	Leaves	Sage	Green
56. Santalum album	Wood	Santalum‡	Yellow
57. Laurus sassafras	Root	Sassafras	Yellow
58. Satureia hortensis	Leaves	Satureia	Yellow
59. Thymus serpillum	Leaves and flower	Thyme	Yellow
60. Valeriana officinalis	Root	Valerian	Green
61. Kæmpferia rotunda	Root	Zedoary	Greenish blue
62. Amomum Zinziber	Root	Ginger	Yellow
63. Andropogon schænanthum		Sira	Brown

* The oils marked ‡ sink in water. They yield also a fixed oil.

Several of the gum resins, as *myrrh* and *galbanum*, yield likewise an essential oil, and likewise the balsam of *benzoin*, &c.

Sect. XX. *Of Wax.*

The upper surface of the leaves of many trees is covered with a varnish, which may be separated and obtained in a state of purity by the following process:

Digest the bruised leaves, first in water and then in alcohol, till every part of them which is soluble in these liquids, be extracted. Then mix the residuum with six times its weight of a solution of pure ammonia, and, after sufficient maceration, decant off the solution, filter it, and drop into it, while it is incessantly stirred, diluted sulphuric acid, till more be added than is sufficient to saturate the alkali. The varnish precipitates in the form of a yellow powder. It should be carefully washed with water, and then melted over a gentle fire.

Mr Tingry first discovered that this varnish possesses all the properties of *bees wax*. Wax, then, is a vegetable product. Several plants contain wax in such abundance as to make it worth while to extract it from them. But let us, in the first place, consider the properties of bees wax, the most common and important species. This substance, as Huber has demonstrated, contrary to the generally received opinion, is prepared by the bees from honey or sugar, the latter yielding the greatest proportion of it.

Wax when pure, is of a whitish colour; it is destitute of taste, and has scarcely any smell. Bees wax, indeed, has a pretty strong aromatic smell; but this seems chiefly owing to some substance with which it is mixed; for it disappears almost completely by exposing the wax, drawn out into thin ribands, for some time to the atmosphere. By this process, which is called *bleaching*, the yellow colour of the wax disappears, and it becomes very white. Bleached wax is not affected by the air.

The specific gravity of unbleached wax varies from 0.9000 to 0.9650; that of white wax from 0.8203 to 0.9662.

Wax is insoluble in water; nor are its properties altered though kept under that liquid.

When heat is applied to wax it becomes soft; and at the temperature of 142°, if unbleached, or of 155° if bleached, it melts into a colourless transparent fluid, which concretes again, and resumes its former appearance as the temperature diminishes. If the heat be still farther increased, the wax boils and evaporates; and if a red heat be applied to the vapour, it takes fire and burns with a bright flame. It is this property which renders wax so useful for making candles.

Wax is scarcely acted on by alcohol when cold, but boiling alcohol dissolves it.

Ether has but little action on wax while cold; but when assisted by heat, it takes up about one-twentieth of its weight of it, and lets the greatest part precipitate on cooling.

Wax combines readily with fixed oils when assisted by heat, and forms with them a substance of greater or less consistency, according to the quantity of oil. This composition, which is known by the name of *cerate*, is much employed by surgeons.

The volatile oils also dissolve wax when heated. This is well known, at least, to be the case with oil of turpentine. A part of the wax precipitates usually as the solution cools, but of a much softer consistence than usual, and therefore containing oil.

The fixed alkalies combine with it, and form a compound which possesses all the properties of common soap. When boiled with a solution of fixed alkalies in water, the liquid becomes turbid, and after some time the soap separates and swims on the surface. It is precipitated from the alkali by acids in the state of flakes, which are the wax very little altered in its properties.

The acids have but little action on wax; even oxymuriatic acid, which acts so violently on most bodies, produces no other change on it than that of rendering it white. This property which wax possesses, of resisting the action of acids, renders it very useful as a lute to confine acids properly in vessels, or to prevent them from injuring a common cork.

Mr Lavoisier contrived to burn wax in oxygen gas. The quantity of wax consumed was 21.9 grains. The oxygen gas employed in consuming that quantity amounted to 66.55 grains. Consequently, the substances consumed, amounted to 88.45 grains. After the combustion, there were found in the glass vessel 62.58 grains of carbonic acid, and a quantity of water, which was supposed to amount to 25.87 grains. These were the only products.

From this experiment he concluded, that 100 parts of wax are composed of

82.28	carbon
17.72	hydrogen
100.00	

But according to the experiments of Thenard and Gay Lussac, it is composed of

Carbon	81.784
Hydrogen	12.672
Oxygen	5.544
	100.00

The myrtle wax of North America is obtained from the *myrica cerifera*. The *myrica cerifera* is a shrub which grows abundantly in Louisiana and other parts of North America. It produces a berry about the size of a pepper corn. A very fertile shrub yields nearly seven pounds. From the observations of Cadet, we learn that the wax forms the outer covering of the berries. The wax thus obtained is of a pale green colour. Its specific gravity is 1.0150. It melts at the temperature of 109°: when strongly heated it burns with a white flame, produces little smoke, and during the combustion emits an agreeable aromatic odour. Water does not act upon it. Alcohol, when hot, dissolves one-tenth of its weight, but lets most of it fall again on cooling. Hot ether dissolves about one-fourth of its weight; and when slowly cooled, deposites it in crystalline plates, like spermaceti. The ether acquires a green colour, but the wax becomes nearly white. Oil of turpentine, when assisted by heat, dissolves it sparingly. Alkalies act upon it nearly as on bees wax. The same remark applies to acids. Sulphuric acid, when assisted by heat, dissolves about one-twelfth of its weight, and is converted into a thick dark brown mass.

The Chinese extract a wax from various vegetables, which they manufacture into candles, and of which they form many delicate ornaments which are brought to Europe.

Sect. XXI. *Camphor.*

The substance called *camphor*, though unknown to the Greeks and Romans, seems to have been long known in the East. When it was first brought to Europe does not appear, though it seems to have been introduced by the Arabians.

It comes to Europe chiefly from Japan. It is obtained from the *laurus camphora*, a tree common in the East, by distilling the wood along with water in large iron pots, on which are fitted earthen heads stuffed with straw. The camphor sublimes, and concretes upon the straw in the form of a grey powder. It is afterwards refined in Holland by a second sublimation. The vessels are of glass, and somewhat of the shape of a turnip, with a small mouth above loosely covered with paper. According to Ferber, about one-fourth of pounded chalk is mixed with crude camphor; but others assure us that there is no addition whatever employed.*

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* Camphor is refined on an extensive scale in Philadelphia. As we have repeatedly seen the process performed with large quantities, we can assure the reader, that no addition is necessary; perhaps it may interest country practitioners to be informed, that we have repeatedly refined the article with a Florence flask and an argand lamp; the aperture of the flask may be covered with a paper cone, and the heat so regulated, that, whilst the camphor is gently boiling, the neck of the flask may not be too hot to be borne with the fingers.

In the *Medical Museum*, the late Professor Woodhouse published a description of the process, together with a plate of the furnace and vessels: we subjoin as

Camphor thus confined is a white brittle substance, having a peculiar aromatic odour, and a strong hot acrid taste. Its specific gravity is 0.9887.

It is not altered by atmospheric air; but it is so volatile, that if it be exposed during warm weather in an open vessel, it evaporates completely. When sublimed in close vessels it crystallizes in hexagonal plates or pyramids.

It is insoluble in water; but it communicates to the liquid a certain portion of its peculiar odour.

It dissolves readily in alcohol, and is precipitated again by water. According to Neumann, well rectified alcohol dissolves three-fourths of its weight of camphor. By distillation the alcohol passes over first, and leaves the camphor. This property affords an easy method of purifying camphor. Dissolve the camphor in alcohol, distil off the spirit, and melt the camphor into a cake in a glass vessel.

Camphor is soluble also in oils, both fixed and volatile. If the solution be made by means of heat, as it cools part of the camphor precipitates, and assumes the form of plumose or feather-like crystals.*

Camphor is not acted on by alkalies, either pure or in

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much of his description, as may enable any person to conduct the process.

"A furnace sufficiently large for one active and industrious man to attend, will occupy the space of eight feet nine inches in length, and two feet six inches in breadth. It must be made of seven cast-iron plates, half an inch thick, thirty inches long and fifteen broad. These plates are to be placed on eight piles of bricks, parallel to each other, and nine inches apart. The bricks are to be ten inches high, thirty long, and six broad.

"Great care must be taken, that the lower sides of the plates meet each other exactly midway on the upper sides of the bricks, which should be well covered with a thick bed of mortar. Bricks serve to confine the sand. When the furnace is connected with a wall, there is no occasion for more than a single row of them: and to obtain a considerable draught of air, a chimney should be carried from the fourth plate, with an aperture four inches in diameter, and the flues of the third and fifth plates may communicate with this chimney. Two separate flues may be carried from the second and sixth plates, and the first and seventh should enter the second and sixth.

"The vessels are made of green glass. They should be blown very thin, circular, and shaped like a flat turnip, having a neck an inch or more in length, with an aperture about half or one inch in diameter. Their bottoms should be eleven inches broad, and the top ought to be four inches from the bottom.

"The pans are made of sheet iron or copper. They should be round, and about two inches more in diameter than the subliming vessels, about five inches high, having a rim pecked round them with two handles.

"The glass vessels are filled about two-thirds with crude camphor, and the aperture in the necks slightly stopped, with paper or cotton plugs. They are then to be placed on the bottom of the pans, and covered nearly to the base of their necks with sand.

"The pans, holding the vessels containing the camphor, are to be placed in the sand-bath, and surrounded near to the rim with sand.

"A gentle fire is to be kindled in the furnace, at four o'clock in the morning, and gradually increased, until the camphor melts, which it does when it arrives at 304° of Fahrenheit's thermometer. It will first rise in flowers, which will dissolve, and run down the sides of the vessel. When it has melted, or is boiling, the glass is to be elevated in such a manner that the hot sand may reach only to the middle of its belly, in order that the cool air may be admitted to the upper surface of the glass, to congeal the camphor as it sublimes.

"Having kept it in a liquid or boiling state, from eight to ten hours, the refined camphor will be found adhering to the upper side of the vessel, from which it may be removed by breaking the glass vessel, and removing the camphor by a knife."

The foul parts which remain at the bottom of the vessel, are to be reserved, and when a sufficient quantity are accumulated, they are to be put in a vessel and sublimed by themselves; by which proceeding there will be very little loss in the product.

"If any of the vessels holding the melted camphor should crack, which sometimes happens, and which is discovered, by the flowers rising into the air from their sides and tops, the pans containing them are to be immediately removed from the bath; and if the camphor is found mixed with the sand, the whole is to be put into other vessels, and the operation conducted as before."

In addition to the above description we will add, that the plugs with which the vessels are stopped should be frequently moved, as some of the sublimed camphor concretes to their under surface, and accumulates until the plug is united to the neck of the vessel; an elastic vapour, which appears to be an essential oil, being thus confined, blows the vessel to pieces; the camphor being diffused in the atmosphere, takes fire, and communicates the flame to all the vessels in the bath: hence the process is a dangerous one, in other than a fire-proof building. Another necessary precaution is, that the bath should be as uniformly heated as possible, that the camphor in all the vessels may boil gently together: otherwise, the camphor in the vessels which are too hot, instead of concreting to their upper surfaces, remains fluid, and runs down into the boiling camphor again. By inattention to the above precaution, we have seen the successful labour of nine hours destroyed in an instant: the fire was thoughtlessly increased, whereby the camphor which had already concreted, was melted, and the refination had to be commenced the next day.

References to Plate CXLII. No. 2.

Fig. 1. Is a perspective view of the furnace, supporting a sand-bath.

Fig. 2. Is the subliming vessel.

Fig. 3. Is the iron pan, containing one of the vessels.

Hembel, jun.

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* Camphor, it has been lately asserted is soluble in milk. This is apparently a mistake; that fluid will suspend it largely in minute division; but, in a few days, the whole precipitates, and the milk is not prevented from undergoing its usual changes. It is, nevertheless, an excellent medium for the medicinal employment of camphor. Coxe.

the state of carbonates. Pure alkalies, indeed, seem to dissolve a little camphor; but the quantity is too small to be perceptible by any other quality than its odour. Neither is it acted on by any of the neutral salts which have hitherto been tried.

Acids dissolve camphor without effervescence, and in general it may be precipitated unaltered from the recent solution.

When heat is applied to camphor it is volatilized. If the heat be sudden and strong, the camphor melts before it evaporates; and it melts, according to Venturi, at the temperature of 300°; according to Romieu, at 421°. It catches fire very readily, and emits a great deal of flame as it burns, but it leaves no residuum. It is so inflammable that it continues to burn even on the surface of water. When camphor is set on fire in a large glass globe, filled with oxygen gas, and containing a little water, it burns with a very bright flame, and produces a great deal of heat. The inner surface of the glass is soon covered with a black powder, which has all the properties of charcoal; a quantity of carbonic acid gas is evolved; the water in the globe acquires a strong smell, and is impregnated with carbonic acid and camphoric acid.

There are several species of camphor which have been examined by chemists, and which differ considerably from each other in their properties. The most remarkable are *common camphor*, the *camphor of volatile oils*, and the *camphor* obtained by treating *oil of turpentine* with *muriatic acid*.

Common camphor, obtained by distillation from the *laurus camphora*, is the substance which has been described in the preceding part of this Chapter. In Borneo and Sumatra camphor is procured from the *laurus sumatrensis*; but as none of this camphor is brought to Europe, we do not know how far it agrees with common camphor in its properties. The *laurus cinnamomum* likewise yields camphor.

The second species of camphor seems to exist in a great variety of plants, and is held in solution by the volatile oils extracted from them. Neumann obtained it from oils of thyme, marjoram, cardomum; Hermann, from oils extracted from various species of mint. Cartheuser obtained it from the roots of the *maranta galanga*, *hæmpferia rotunda*, *amomum zinziber*, *laurus cassia*, and rendered it probable that it is contained in almost all the labiated plants. It has been supposed to exist in these plants combined with volatile oil. Proust has shown how it may be extracted, in considerable quantity, from many volatile oils.

From the observations of Mr John Brown, there is reason to believe that the camphor from oil of thyme differs from common camphor in several respects. It does not appear to form a liquid solution either with nitric or sulphuric acid; nor is it precipitated from nitric acid in powder like common camphor, but in a glutinous mass.

The artificial camphor yielded by oil of turpentine, when saturated with muriatic acid gas, was discovered by Mr Kind, apothecary in Eutin, while employed in making a medicine called the *liquor arthriticus Pottii*. He put a quantity of oil of turpentine into a Woulfe's bottle, and caused a current of muriatic acid gas, separated from common salt by sulphuric acid, to pass through it. The salt used was of the same weight with the oil of turpentine. At first the oil became yellow, then brown, and at last became almost solid, from the formation of a great number of crystals in it, which possessed the properties of camphor.

The proportion of muriatic gas found to answer best, is what can be separated by sulphuric acid and heat from a quantity of common salt equal in weight to the oil of turpentine employed. The camphor produced amounts nearly to one-half of the oil of turpentine.

The camphor thus produced was very white; it had a peculiar odour, in which that of the oil of turpentine could be distinguished. When washed with water it became beautifully white, and gave no longer signs of containing an acid, but still had the smell of oil of turpentine. Water containing some carbonate of potash deprived it of part of this odour, but not the whole. When mixed with its own weight of charcoal powder, wood-ashes, quicklime, or porcelain clay, and sublimed, it was obtained in a state of purity.

Its smell, when pure, resembles that of common camphor, but is not so strong. Its taste also resembles that of camphor. It swims on water, to which it communicates its taste, and burns upon its surface. It dissolves completely in alcohol,* and is precipitated by water. Nitric acid, of the specific gravity 1.261, had no action on it, though it readily dissolves common camphor; but concentrated nitric acid dissolves it with the disengagement of nitrous gas; and water does not precipitate it from its solution as it does common camphor. Acetic acid does not dissolve it. When heated it sublimes without decomposition; and when set on fire it burns like camphor.

Sect. XXII. *Of Bird lime.*

The vegetable principle to which we give the name of *bird-lime*, was first examined by Vauquelin, who found it possessed of properties different from every other. It was found collected on the epidermis of a plant brought to Europe by Michaud, and called *robinia viscosa* by Cels, constituting a viscid substance, which made the fingers adhere to the young twigs. From the late analysis of *bird-lime* by Bouillon la Grange, it is obvious that it owes its peculiar properties to the presence of an analogous substance, which indeed constitutes the essential part of that composition. Hence the reason why we have given the name of *bird-lime* to the principle itself.

Natural bird-lime (or that which exudes spontaneously from plants) possesses the following properties:

Its colour is green; it has no sensible taste or smell; is extremely adhesive; softens by the heat of the fingers, and sticks to them with great obstinacy. When heated it melts, swells up, and burns with a considerable flame, leaving a bulky charcoal behind it. It does not dissolve in water; alcohol has but little action on it, especially when cold. By the assistance of heat it dissolves a portion of it; but on cooling, allows the greatest part to precipitate again. When exposed to the air it continues glutinous, never becoming hard and brittle like the resins.

It combines readily with oils. Ether is its true solvent, dissolving it readily without the assistance of heat. The solution is of a deep green colour. The alkalies do not combine with it; the effect of the acids was not tried. These properties are sufficient to distinguish bird-lime from every other vegetable principle.

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* If a saturated solution of it in alcohol be made by heat, the excess of camphor falls down in beautiful crystals as the solution cools, somewhat resembling muriat of ammonia.—This species of camphor is not formed by passing the muriatic acid gas through oil of sassafras. The oil assumes a dark colour, but does not lose its peculiar smell. Coxe.

Artificial bird-lime is prepared from different substances in different countries. The berries of the misletoe are said to have been formerly employed. They were pounded, boiled in water, and the hot water poured off. At present bird-lime is usually prepared from the middle bark of the holly. The process followed in England, as described by Geoffroy, is as follows: The bark is boiled in water seven or eight hours, till it becomes soft. It is then laid in quantities in the earth, covered with stones, and left to ferment or rot for a fortnight or three weeks. By this fermentation it changes to a mucilaginous consistency. It is then taken from the pits, pounded in mortars to a paste, and well washed with river water. Bouillon la Grange informs us, that at Nogent le Rotrou bird-lime is made by cutting the middle bark of the holly into small pieces, fermenting them in a cool place for a fortnight, and then boiling them in water, which is afterwards evaporated. At Commerci various other plants are used.

Its colour is greenish, its flavour sour, and its consistence gluey, stringy, and tenacious. Its smell is similar to that of linseed oil. When spread on a glass plate, and exposed to the air and light, it dries, becomes brown, loses its viscidity, and may be reduced to powder; but when water is added to it, the glutinous property returns. It reddens vegetable blues.

When gently heated it melts, and emits an odour like that of animal oils. When heated on red hot coals, it burns with a lively flame, and gives out a great deal of smoke, leaving a white ash, composed of carbonet of lime, alumina, iron, sulphate, and muriate of potash.

Water has little action on bird-lime. When boiled in water the bird-lime becomes more liquid, but recovers its original properties when the water cools. The water, by this treatment, acquires the property of reddening vegetable blues, and when evaporated leaves a mucilaginous substance, which may be likewise separated by alcohol.

A concentrated solution of potash forms with bird-lime a whitish magma, which becomes brown by evaporation, while ammonia separates. The compound thus formed is less viscid than bird-lime, and in smell and taste resembles soap. In alcohol and water it dissolves almost completely, and possesses properties similar to those of soap.

Weak acids soften bird-lime, and partly dissolve it; strong acids act with more violence. Sulphuric acid renders it black; and when lime is added to the solution, acetic acid and ammonia separate. Nitric acid cold has little effect; but when assisted by heat it dissolves the bird-lime; and the solution, when evaporated, leaves behind it a hard brittle mass. By treating this mass with nitric acid, a new solution may be obtained, which by evaporation yields malic and oxalic acids, and a yellow matter which possesses several of the properties of wax. Cold muriatic acid does not act on bird-lime; hot muriatic acid renders it black.

Alcohol of the specific gravity 0.817 dissolves bird-lime at a boiling heat. On cooling, it lets fall a yellow matter similar to wax. The filtered liquid is bitter, nauseous, and acid. Water precipitates a substance similar to resin.

Sulphuric ether dissolves bird-lime readily, and in great abundance. The solution is greenish. When mixed with water, an oily substance separates, which has some resemblance to linseed oil. When evaporated, a greasy substance is obtained, having a yellow colour and the softness of wax. Oil of turpentine dissolves bird lime readily.

Sect. XXIII. *Of Resins.*

It is at present the opinion of chemists, that *resins* stand in the same relation to the *volatile* oils that *wax* does to the *fixed*. Wax is considered as a fixed oil saturated with oxygen; resins, as volatile oils saturated with the same principle.

Resins often exude spontaneously from trees; they often flow from artificial wounds, and not uncommonly are combined at first with volatile oil, from which they are separated by distillation. The reader can be at no loss to form a notion of what is meant by *resin*, when he is informed that common *rosin* furnishes a very perfect example of a resin, and that it is from this substance that the whole genus derived their name: for rosin is frequently denominated *resin*.

I. Resins may be distinguished by the following properties:

They are solid substances, naturally brittle; have a certain degree of transparency, and a colour most commonly inclining to yellow. Their taste is more or less acrid, and not like that of volatile oils; but they have no smell unless they happen to contain some foreign body. They are all heavier than water. They are all non-conductors of electricity; and when excited by friction, their electricity is negative.

Their specific gravity varies considerably.

When exposed to heat, they melt; and if the heat be increased, they take fire, and burn with a strong yellow flame, emitting at the same time a vast quantity of smoke.

They are all insoluble in water, whether cold or hot; but when they are melted along with water, or mixed with volatile oil, and then distilled with water, they seem to unite with a portion of that liquid; for they become opake, and lose much of their brittleness. This at least is the case with common rosin.

They are all, with a few exceptions, soluble in alcohol, especially when assisted by heat. The solution is usually transparent; and when the alcohol is evaporated, the resin is obtained unaltered in its properties.

Several of them are soluble in fixed oils, especially in the drying oils. The greater number are soluble in the volatile oils; at least in oil of turpentine, the one commonly employed.

Mr Hatchett first examined the action of fixed alkalies on resins, and ascertained, contrary to the received opinion of chemists, that alkaline leys dissolve them with facility. He reduced a quantity of common rosin to powder, and gradually added it to a boiling lixivium of carbonate of potash; a perfect solution was obtained of a clear yellow colour, which continued after long exposure to the air. The experiment succeeded equally with carbonate of soda, and with solutions of pure potash, or soda. Every other resin was dissolved as well as *rosin*.

These alkaline solutions of resins have the properties of soap, and may be employed as detergents. When mixed with an acid, the resin is separated in flakes, usually of a yellow colour, and not much altered in its nature.

Ammonia acts but imperfectly upon resins, and does not form a complete solution of any of those bodies hitherto tried.

It was the received opinion of chemists, that acids do not act upon resins. Mr Hatchett first ascertained this opinion also to be erroneous, and showed that most of the acids dissolve resins with facility, producing different phenomena according to circumstances.

When sulphuric acid is poured upon any of the resins in powder, it dissolves them in a few minutes. At first the solution is transparent, of a yellowish brown colour, and of the consistency of a viscid oil, and the resin may be precipitated nearly unaltered by the addition of water. If the solution be placed on a sand bath, its colour becomes deeper, sulphurous acid gas is emitted, and it becomes very thick, and of an intense black.

Nitric acid likewise dissolves the resins with facility, but not without changing their nature. Mr Hatchett was first led to examine the action of this acid on resins, by observing that resins are thrown down by acids from their solutions in alkalies in the state of a curdy precipitate; but when nitric acid is added in excess, the whole of the precipitate is re-dissolved in a boiling heat. He poured nitric acid of the specific gravity 1.38, on powdered rosin in a tubulated retort; and by repeated distillation formed a complete solution of a brownish yellow colour. The solution takes place much sooner in an open matrass than in close vessels. The solution continues permanent, though left exposed to the air. It becomes turbid when water is added; but when the mixture is boiled, the whole is re-dissolved.

When the digestion of nitric acid upon a resinous substance is continued long enough, and the quantity of acid is sufficient, the dissolved resin is completely changed; it is not precipitated by water; and by evaporation, a viscid substance of a deep yellow colour is obtained, equally soluble in water and alcohol, and seemingly intermediate between resin and extractive. If the abstraction of nitric acid be repeated, this substance gradually assumes the properties of artificial tannin. Thus it appears that nitric acid gradually alters the nature of resin, producing a suite of changes which terminate in artificial tannin, upon which nitric acid has no action.

Muriatic acid and acetic acid dissolve resin slowly, and it may be precipitated again from them unaltered.

When resins are subjected to destructive distillation, we obtain carbureted hydrogen and carbonic acid gas, a very small portion of acidulous water, and much empyreumatic oil. The charcoal is light and brilliant, and contains no alkali.

II. Having now described the general properties of resinous bodies, it will be proper to take a more particular view of those of them which are of the most importance, that we may ascertain how far each possesses the general character of resins, and by what peculiarities it is distinguished from the rest. The most distinguished of the resins are the following.

1. *Rosin.*—This substance is obtained from different species of *fir*; as the *pinus abies*, *sylvestris*, *larix*, *balsamea*. It is well known that a resinous juice exudes from the *pinus sylvestris*, or common Scotch fir, which hardens into tears. The same exudation appears in the *pinus abies*, or spruce fir. These tears constitute the substance called *thus*, or common frankincense. When a portion of bark is stripped off these trees, a liquid juice flows out, which gradually hardens. This juice has obtained different names, according to the plant from which it comes. The *pinus sylvestris* yields *common turpentine*; the *larix*, *Venice turpentine*; the *balsamea*, *balsam of Canada*, &c. All these juices, which are commonly distinguished by the name of turpentine, are considered as composed of two ingredients; namely, oil of turpentine and rosin.

According to the experiments of Thenard and Gay Lussac, it is composed of

Carbon,	75.944
Oxygen,	13.337
Hydrogen,	10.719
	100.000

2. *Mastich.*—This resin is obtained from the *pistacia lentiscus*; a tree which grows in the Levant, particularly in the island of Chios. When transverse incisions are made into this tree, a fluid exudes, which soon concretes into yellowish semitransparent brittle grains. It softens when kept in the mouth, but imparts very little taste. When heated, it melts and exhales a fragrant odour. Its taste is slight, but not unpleasant. In Turkey, great quantities of it are said still to be chewed for sweetening the breath, and strengthening the gums. It is to this use of the resin as a masticatory that it is supposed to owe its name. Mastich does not dissolve completely in alcohol; a soft elastic substance separates during the solution. The nature of this insoluble portion was first examined by Kind, who found it possessed of all the properties of caoutchouc. These experiments have lately been repeated by Mr Matthews with a similar result. Mr Brande, however, has observed, that when this insoluble substance is dried, it becomes brittle, in which respect it differs from caoutchouc. He has observed also, that by passing a current of oxymuriatic gas through the alcoholic solution of mastich, a tough elastic substance is thrown down, precisely similar to the original insoluble portion.

3. *Sandarach.*—This resin is obtained from the *juniperus communis*, or common juniper. It exudes spontaneously, and is usually in the state of small round tears of a brown colour, and semitransparent, not unlike mastich, but rather more transparent and brittle. When chewed it does not soften as mastich does, but crumbles to powder. Mr Matthews found it almost completely soluble in eight times its weight of alcohol. The residue was extraneous matter. It does not dissolve in tallow or oil, as common resin does.

4. *Elemi.*—This resin is obtained from the *amyris elemifera*, a tree which grows in Canada and Spanish America. Incisions are made in the bark during dry weather, and the resinous juice which exudes is left to harden in the sun. It comes to this country in long roundish cakes wrapped in flag leaves. It is of a pale yellow colour, semitransparent; at first softish, but it hardens by keeping. Its smell is at first strong and fragrant, but it gradually diminishes.

5. *Tacamahac.*—This resin is obtained from the *fagara octandra*, and likewise, it is supposed, from the *populus balsamifera*. It comes from America in large oblong masses wrapt in flag leaves. It is of a light brown colour, very brittle, and easily melted when heated. When pure it has an aromatic smell, between that of lavender and musk.

6. *Animé.*—This resin is obtained from the *hymenæ courbaril*, or locust tree, which is a native of North America. Animé resembles copal very much in its appearance; but is readily soluble in alcohol, which copal

is not: this distinguishes them. It is said to be very frequently employed in making varnishes. Alcohol dissolves it completely.

7. *Ladanum* or *labdanum*.—This resin is obtained from the *cystus creticus*, a shrub which grows in Syria and the Grecian islands. The surface of this shrub is covered with a viscid juice, which, when concreted, forms ladanum. It is collected, while moist, by drawing over it a kind of rake with thongs fixed to it. From these thongs it is afterwards scraped with a knife. It is always mixed with dust and sand, sometimes in great abundance. The best is in dark coloured masses, almost black, and very soft, having a fragrant odour and a bitterish taste. The impurities, even in the best kinds, amount to about one-fourth.

8. *Botany Bay resin*.—This resin is said to be the produce of the *acarois resinifera*, a tree which grows abundantly in New Holland, especially near Botany Bay. Specimens of it were brought to London about the year 1799, where it was tried as a medicine.

The resin exudes spontaneously from the trunk of the singular tree which yields it, especially if the bark be wounded. It is at first fluid, but becomes gradually solid when dried in the sun. It consists of pieces of various sizes, of a yellow colour, unless when covered with a greenish grey crust. It is firm, yet brittle; and when pounded, does not stick to the mortar nor cake. In the mouth it is easily reduced to powder without sticking to the teeth. It communicates merely a slight sweetish astringent taste. When moderately heated, it melts; on hot coals it burns to a coal, emitting a white smoke, which has a fragrant odour somewhat like storax. When thrown into the fire, it increases the flame like pitch. It communicates to water the flavour of storax, but is insoluble in that liquid. When digested in alcohol, two-thirds dissolve: the remaining third consists of one part of extractive matter, soluble in water, and having an astringent taste; and two parts of woody fibre and other impurities, perfectly tasteless and insoluble. The solution has a brown colour, and exhibits the appearance and the smell of a solution of benzoin. Water throws it down unaltered. When distilled, the products were water and empyreumatic oil, and charcoal; but it gives no traces of any acid, alkali, or salt, not even when distilled with water.

9. *Copal*.—This substance, which deserves particular attention from its importance as a varnish, and which at first sight seems to belong to a distinct class from the resins, is obtained, it is said, from the *rhus copallinum*, a tree which is a native of North America; but the best sort of copal is said to come from Spanish America, and to be the produce of different trees. No less than eight species are enumerated by Hernandez.

Copal is a beautiful white resinous substance, with a slight tint of brown. It is sometimes opaque, and sometimes almost perfectly transparent. When heated, it melts like other resins; but it differs from them in not being soluble in alcohol, nor in oil of turpentine without peculiar management.* Neither does it dissolve in the fixed oils with the same ease as the other resins. It resembles gum animé a little in appearance; but is easily distinguished by the solubility of this last in alcohol, and by its being brittle between the teeth, whereas animé softens in the mouth. The specific gravity of copal varies, according to Brisson, from 1.045 to 1.139. Mr Hatchett found it soluble in alkalies and nitric acid with the usual phenomena; so that in this respect it agrees with the other resins. The solution of copal in alkalies he found indeed opalescent, but it is nevertheless permanent. It deserves attention, that he found rosin, when dissolved in nitric acid, and then thrown down by an alkali, to acquire a smell resembling that of copal.

When copal is dissolved in any volatile liquid, and spread thin upon wood, metal, paper, &c. so that the volatile menstruum may evaporate, the copal remains perfectly transparent, and forms one of the most beautiful and perfect varnishes that can well be conceived. The varnish thus formed is called *copal varnish*, from the chief ingredients in it. This varnish was first discovered in France, and was long known by the name of *vernis martin*. The method of preparing it is concealed; but different processes for dissolving copal in volatile menstrua have been from time to time made public.

According to the experiments of Thenard and Gay Lussac, copal is composed of

Carbon . .	76.811
Oxygen . .	10.606
Hydrogen .	12.583
	100.000

10. *Lac*.—This is a substance deposited on different species of trees in the East Indies, by an insect called *chermes lacca*, constituting a kind of comb or nidus. It has been imported into Europe, and extensively used from time immemorial: but it is only of late years that correct information concerning it has been obtained. For what relates to the natural history of the insect, and the mode of forming the lac, we are indebted to Mr Ker, Mr Saunders, and Dr Roxburgh. Though very often employed in the arts, it was neglected by chemists. Mr Hatchett has lately examined it with his usual address, and ascertained its composition and properties.

There are various kinds of lac distinguished in commerce. *Stick lac* is the substance in its natural state, encrusting small twigs. When broken off and boiled in water, it loses its red colour, and is called *seed lac*. When melted and reduced to the state of thin crust, it is called *shell lac*. Stick lac is of a deep red colour, and yields to water a substance which is used as a red dye. The other two varieties are brown.

Water dissolves the greatest part of the colouring matter of lac, which varies from 15 to ½ per cent. Alcohol dissolves the greatest part of the resin, which constitutes the chief ingredient in the composition of lac. Ether acts more feebly. Sulphuric acid dissolves and gradually chars lac; nitric acid dissolves, and then produces the same changes on it as on other resinous bodies. Muriatic and acetic acids likewise act as solvents. A solution of borax in water readily dissolves lac. The best proportions are 20 grains of borax, 100 grains of lac, and four ounces of water. This solution, mixed with lamp black, constitutes Indian ink, and may indeed be employed for many of the purposes of varnish. The fixed alkalies readily dissolve lac, but not the volatile. When placed on a hot iron it melts, and emits a thick smoke with an odour rather pleasant, leaving a spongy coal. When distilled, it yields water slightly acidulous, and a thick butyraceous oil. The gases emitted are a mixture of carbonic acid and carbureted hydrogen. Stick lac yields also some carbonate of ammonia; but the other two varieties none. The following Table exhibits the constituents of the different varieties of lac, according to the analysis of Mr Hatchett.

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* It is nevertheless soluble in pure alcohol, as may be seen in note page 708. Thomas Cooper, Esq. Professor of Chemistry in Carlisle College, informed us, that copal is soluble in common oil of turpentine, by continued digestion in a heat about 150°. HEMBEL, jun.

	Stick Lac.	Seed Lac.	Shell Lac.
Resin . . .	68	88.5	90.9
Colouring matter	10	2.5	0.5
Wax . . .	6	4.5	4.0
Gluten . . .	5.5	2.0	2.8
Foreign bodies	6.5		
Loss . . .	4.0	2.5	1.8
	100	100	100

The resin is less brittle than those bodies usually are. The colouring matter possesses the properties of extractive; the wax is analogous to myrtle wax, and the gluten closely resembles the gluten of wheat.

11. *Amber.*—This substance is undoubtedly of vegetable origin; and though it differs from resins in some of its properties, yet it agrees with them in so many others, that it may, without impropriety, be referred to them.

Amber is a brittle, light, hard substance, usually nearly transparent; sometimes nearly colourless, but commonly yellow or even deep brown. It has considerable lustre. Its specific gravity is 1.065. It is tasteless, and without smell, except when pounded or heated, when it emits a fragrant odour. When heated it softens; but, as far as is known, cannot be melted without losing some of its weight, and altering its appearance. In a strong heat it burns, leaving a small quantity of ashes, the nature of which has not yet been ascertained. Water has no action on it; but alcohol, by long digestion, dissolves about one eighth of the amber, and forms a coloured solution, which, when concentrated, becomes milky when mixed with water. The residuum of the amber is not acted on by alcohol. Though amber be roasted before the action of the alcohol, the tincture is still formed. Hence we learn that the resinous part of amber is not expelled by a melting heat.

The weaker acids have no action on amber. Sulphuric acid converts it into a black resinous mass. Nitric acid acts upon it; when assisted by heat, nitrous gas is emitted.

Neither fixed nor volatile oils have any action on amber, unless it has been previously roasted or exposed to a melting heat. When thus treated, it combines with oils, and the solution forms *amber varnish.* The process recommended by Nystrom is this: Amber is to be spread on a flat-bottomed iron pan, and placed on an equal coal fire till it melts; it is then to be withdrawn, covered with a plate of copper and iron, and allowed to cool. If the process be properly conducted, the amber will have lost half of its weight. If the fire be too strong, the amber will be scorched and rendered useless. If it be too low, the amber will not melt, but be reduced to a brown crust, which answers well enough for a varnish, provided it be exposed to heat till it is reduced to one half of the original weight. One part of this roasted amber is to be mixed with three parts of the linseed oil (rendered drying by litharge and white vitriol,) and the mixture exposed to a gentle heat till the amber is dissolved: it is then to be withdrawn from the fire, and when nearly cold, four parts of oil of turpentine are to be added. The whole is then allowed to settle, and the clear portion is passed through a linen cloth.

Sect. XXIV. *Of Guaiacum.*

This substance is obtained from the *guaiacum officinale*, a tree which is a native of the West Indies, and yields a very hard heavy wood. The resin exudes spontaneously, and is also driven out artificially, by heating one end of the wood in billets previously bored longitudinally; the melted resin runs out at the extremity farthest from the fire. This substance has been used in medicine for a considerable time, having been originally recommended in venereal diseases. Nothing is known concerning its original introduction into Europe.

It was considered by chemists as a resin, till Mr Hatchett observed, that when treated with nitric acid it yielded products very different from those of the resinous bodies. This induced Mr William Brande to examine its chemical properties in detail.

Guaiacum is a solid substance, resembling a resin in appearance. Its colour differs considerably, being partly brownish, partly reddish, and partly greenish; and it always becomes green when left exposed to the light in the open air. It has a certain degree of transparency, and breaks with a vitreous fracture. When pounded it emits a pleasant balsamic smell, but has scarcely any taste, although when swallowed it excites a burning sensation in the throat. When heated it melts, and diffuses at the same time a pretty strong fragrant odour. Its specific gravity is 1.2289.

When guaiacum is digested in water, a portion of it is dissolved, the water acquiring a greenish brown colour, and a sweetish taste. The liquid, when evaporated, leaves a brown substance, which possesses the property of *extractive.*

Alcohol dissolves guaiacum with facility, and forms a deep brown-coloured solution. Water renders this solution milky by separating the resin. Muriatic acid throws down the guaiacum of an ash grey, and sulphuric acid of a pale green colour. Acetic acid and the alkalies occasion no precipitate. Liquid oxymuriatic acid throws it down of a fine pale blue, which does not change when dried. Diluted nitric acid occasions no change at first; but after some hours the liquid becomes green, then blue, and at last brown, and at that period a brown-coloured precipitate falls down. If water be mixed with the liquid when it has assumed a green or a blue colour, green and blue precipitates may be respectively obtained.

Sulphuric ether does not act so powerfully on guaiacum as alcohol. The solution obtained by means of it, exhibits the same properties when treated with re-agents as that in alcohol.

The alkaline solutions, both pure and in the state of carbonates, dissolve guaiacum with facility. Two ounces of a saturated solution of potash dissolved about 65 grains of guaiacum; the same quantity of ammonia only 25 grains; or guaiacum dissolves in about 15 parts of potash, and 35 parts of ammonia.

Most of the acids act upon guaiacum with considerable energy.

Sulphuric acid dissolves it, and forms a deep red liquid, which deposites while fresh a lilac-coloured precipitate when mixed with water. When heat is applied, the guaiacum is charred.

Nitric acid dissolves guaiacum completely without the assistance of heat, and with a strong effervescence. When the solution is evaporated, it yields a very large quantity of oxalic acid. No artificial tannin appears to be formed, but rather a substance possessing the properties of extractive. Diluted nitric acid converts guaiacum into a brown substance, similar to the precipitate obtained by nitric acid from the alcoholic solution of guaiacum. This brown matter possesses the properties of a resin.

Muriatic acid acts but slightly, as the guaiacum soon melts into a blackish mass, which is not acted upon.

When guaiacum is distilled, 100 parts of it yielded to Mr Brande the following products:

Acidulous water	5.5
Thick brown oil	24.5
Thin empyreumatic oil	30.0
Charcoal	30.5
Gases, consisting of carbonic acid and carbureted hydrogen . .	9.5
	100.0

The coal when incinerated left three grains of lime, but no alkaline substance.

SECT. XXV. *Of Balsams.*

The term *balsam* or *balm* was originally confined to a thick fragrant juice obtained from the *amyris gileadensis*, and afterwards applied by chemists to all substances which possess the same degree of consistence and a strong smell, whether natural or artificial. Bucquet restricted the term to those resinous-like substances which yield benzoic acid when heated. This new meaning of the word, which has been adopted by chemists in general, has introduced into the class of balsams several substances which were formerly considered as resins. The word *balsam* originally implied a substance possessing a certain degree of fluidity; but now there are two classes of balsams; the one fluid, and the other solid and brittle.

A balsam, then, is a substance which possesses the general properties of a resin; but which, when heated or digested in acids, yields a portion of benzoic acid. Chemists, in general, have considered them as combinations of a resin with benzoic acid; but Mr Hatchett has made it probable, that the acid is formed at the time of its separation.

They are insoluble in water; but when boiled in that liquid often give out a portion of benzoic acid. Alcohol and ether dissolve them readily. The strong acids likewise dissolve them; and during the solution a portion of benzoic acid is separated. Nitric acid, in some cases, evolves likewise traces of prussic acid. The alkalies act upon them nearly as on the resins. They may be divided into two classes; namely, *liquid* and *solid* balsams.

1. *Liquid Balsams.*

The liquid balsams at present known are four in number; namely,

1. Copaiva.
2. Tolu.
3. Peru.
4. Styrax.

1. *Copaiva.* This balsam is obtained from the *copaifera officinalis*, a tree which grows in South America, and some of the West India Islands. It exudes from incisions made in the trunk of the tree. The juice thus obtained is transparent, of a yellowish colour, an agreeable smell, a pungent taste, at first of the consistence of oil, but it gradually becomes as thick as honey. Its specific gravity is 0.950. When mixed with water and distilled, there comes over with the water a very large quantity of volatile oil. The residuum consists of two substances; namely, the watery portion, and a greyish yellow substance, lying at the bottom of the vessel, which, on exposure to the air, dries, and becomes brittle and transparent. When heated it melts, and possesses the characters of a resin. When distilled it yielded a yellowish thick oil, some acidulous thick water, and a gas, one-sixth of which was carbonic acid, and the remainder seemed to possess the characters of olefiant gas. From these facts, which have been long known, it was concluded, that copaiva is a compound of a resin and a volatile oil, which passes over at a heat inferior to that of boiling water; but the experiments of Schonberg have rendered it much more probable, that the balsam is decomposed when distilled along with water, and that both the oil and resin are new products.

Whether this balsam yields benzoic acid has not been ascertained. Its properties are rather against the probability of its doing so. Indeed it bears a striking resemblance to turpentine in many respects, and ought, along with it, to constitute a class of bodies intermediate between volatile oils and resins, to which the name of *turpentines* might be given.

2. *Balsam of Tolu.* This substance is obtained from the *toluifera balsamum*, a tree which grows in South America. The balsam flows from incisions made in the bark. It comes to Europe in small gourd shells. It is of a reddish brown colour, and considerable consistence; and when exposed to the air, it becomes solid and brittle. Its smell is fragrant, and continues so even after the balsam has become thick by age. When distilled with water it yields very little volatile oil, but impregnates the water strongly with its taste and smell. A quantity of benzoic acid sublimes, if the distillation be continued.

3. *Balsam of Peru.* This substance is obtained from the *myroxylon peruiferum*, which grows in the warm parts of South America. The tree is full of resin, and the balsam is obtained by boiling the twigs in water. It has the consistency of honey, a brown colour, an agreeable smell, and a hot acrid taste. When boiled with water for some time, the liquid separated by the filter reddens vegetable blues, and deposites crystals of benzoic acid on cooling. The water contains no other substance. When distilled with water, it yields a very small quantity of reddish limpid oil.

4. *Styrax.* This is a semifluid juice, said to be obtained from the *liquidambar styraciflua*, a tree which grows in Virginia, Mexico, and some other parts of America. It is prepared, according to Mr Petiver, in the island of Cobross in the Red Sea, from the bark of a tree called *rosa mallos* by the natives, and considered by botanists as the same with the American species. The bark of this tree is boiled in salt water to the consistence of bird-lime, and then put into casks. Its colour is greenish, its taste aromatic, and its smell agreeable. It is easily volatilized by heat. When treated with water, benzoic acid is dissolved. It is totally soluble in alcohol, except the impurities. When exposed to the air, it becomes harder, and absorbs oxygen. When distilled, it yields an acidulous water, having the odour of benzoic acid, a limpid colourless hot oil, a solid coloured oil, benzoic acid, and a mixture of carbonic acid and car

bureted hydrogen. The charcoal is light, and contains some oil.

2. *Solid Balsams.*

The solid balsams at present known are only three in number; namely,

1. Benzoin.
2. Storax.
3. Dragon's blood.

1. *Benzoin.* This substance is the produce of the *styrax benzoe*, a tree which grows in Sumatra, &c. Benzoin is obtained from this tree by incision; a tree yielding three or four pounds. It is a solid brittle substance, sometimes in the form of yellowish white tears joined together by a brown substance, and sometimes in the form of a brown substance not unlike common rosin. It has a very agreeable smell, which is increased by heating the benzoin. It has little taste. Its specific gravity is 1.092.

Cold water has very little effect on benzoin, but boiling water takes up a portion of benzoic acid.

Alcohol dissolves it when assisted by a gentle heat, and forms a deep yellow solution inclining to reddish brown. When this solution is diluted with water, the benzoin precipitates in the form of a white powder.

Ether dissolves benzoin with facility, and the solution with re-agents exhibits the same phenomena as the alcoholic.

Nitric acid acts with violence on benzoin, and converts it into an orange-coloured mass. When assisted by heat, the acid dissolves the benzoin, and, as the solution cools, crystals of benzoic acid gradually separate.

Sulphuric acid dissolves benzoin, while benzoic acid sublimes; the solution is at first a deep red. By continuing the digestion, a portion of artificial tannin is formed, and the charcoal evolved amounts to 0.48 of the benzoin dissolved.

Acetic acid dissolves benzoin without the assistance of heat. When heat is applied, the solution, as it cools, becomes turbid, owing to the separation of benzoic acid.

Benzoin is dissolved, by a boiling lixivium of the fixed alkalies; a dark brown solution is formed, which becomes turbid after some days exposure to the air. Ammonia likewise dissolves benzoin sparingly.

When Mr Brande exposed 100 grains of benzoin in a retort to a heat gradually raised to redness, the products were,

Benzoic acid	9.0
Acidulous water	5.5
Butyraceous and empyreumatic oil	60.0
Charcoal	22.0
Carbureted hydrogen and carbonic acid	3.5
	100.0

2. *Storax.* This is the most fragrant of all the balsams, and is obtained from the *styrax officinalis*, a tree which grows in the Levant, and it is said also in Italy. Sometimes it is in the state of red tears; and this is said to be the state in which it is obtained from the tree. But common storax is in large cakes; brittle, but soft to the touch, and of a reddish brown colour. This is more fragrant than the other sort, though it contains a considerable mixture of saw-dust. It dissolves in alcohol. When distilled with alcohol or with water, scarcely any oil is obtained. When distilled by the naked fire, it seems, from the experiments of Neumann, to yield the same products as benzoin.

3. *Dragon's blood.* This is a brittle substance of a dark red colour, which comes from the East Indies. There are two sorts of it; one in small oval drops or tears of a fine deep red, which becomes crimson when the tears are reduced to powder; the other is in larger masses, some of which are pale red, and others dark. It is probably obtained from different kinds of trees; the *calamus draco* is said to furnish most of what comes from India. The *dracæna draco* and the *pterocarpus draco* are also said to furnish it.

Dragon's blood is brittle and tasteless, and has no sensible smell. Water does not act upon it, but alcohol dissolves the greatest part, leaving a whitish red substance, partially acted upon by water. The solution has a fine deep red colour, which stains marble, and the stain penetrates the deeper the hotter the marble is. It dissolves also in oils, and gives them a deep red colour. When heated, it melts, catches flame, and emits an acid fume similar to that of benzoic acid. When digested with lime, a portion of it becomes soluble in water, and it acquires a balsamic odour. On adding muriatic acid to the solution, a red resinous substance is precipitated, and slight traces of benzoic acid only become perceptible. Nitric acid acts upon it with energy, changes it to a deep yellow, a portion of benzoic acid is sublimed, and a brown mass remains soluble in water, and possessing the properties of artificial tannin.

Sect. XXVI. *Of Caoutchouc.*

About the beginning of the 18th century, a substance called *caoutchouc* was brought as a curiosity from America. It was soft, wonderfully elastic, and very combustible. The pieces of it that came to Europe were usually in the shape of bottles, birds, &c. This substance is very much used in rubbing out the marks made upon paper by a black lead pencil, and therefore in this country it is often called *Indian rubber*.

It is now known, that there are at least two trees in South America from which caoutchouc may be obtained; the *hævea caoutchouc*, and the *jatropha elastica*; and it is exceedingly probable that it is extracted also from other species of *hævea* and *jatropha*. Several trees likewise which grow in the East Indies yield caoutchouc; the principal of these are, the *ficus indica*, the *artocarpus integrifolia*, and the *urceola elastica*.

When any of these plants are punctured, there exudes from it a milky juice, which, when exposed to the air, gradually lets fall a concrete substance, which is caoutchouc.

If oxymuriatic acid be poured into the milky juice, the caoutchouc precipitates immediately, and at the same time the acid loses its peculiar odour. This renders it probable that the formation of the caoutchouc is owing to its basis absorbing oxygen. If the milky juice be confined in a glass vessel containing common air, it gradually absorbs oxygen, and a pellicle of caoutchouc appears on its surface.

Caoutchouc, when pure, is of a white colour, and without either taste or smell. The blackish colour of the caoutchouc of commerce is owing to the method employed in drying it after it has been spread upon moulds. The usual way is to spread a thin coat of the milky juice upon the mould, and then to dry it by exposing it to smoke; afterwards another coat is spread on, which is dried in the same way. Thus the caoutchouc of commerce consists of numerous layers of pure caoutchouc alternating with as many layers of soot.

Caoutchouc is soft and pliable like leather. It is exceedingly elastic and adhesive, so that it may be forcibly stretched out much beyond its usual length, and instantly recover its former bulk when the force is withdrawn. It cannot be broken without very considerable force. Its specific gravity is 0.9335.

Caoutchouc is not altered by exposure to the air; it is perfectly insoluble in water; but if boiled for some time, its edges become somewhat transparent, owing undoubtedly to the water carrying off the soot; and so soft, that when two of them are pressed and kept together for some time, they adhere as closely as if they formed one piece. By this contrivance pieces of caoutchouc may be soldered together, and thus made to assume whatever shape we please.

Caoutchouc is insoluble in alcohol. This property was discovered very early, and fully confirmed by the experiments of Mr Macquer. The alcohol, however, renders it colourless.

Caoutchouc is soluble in ether. This property was first pointed out by Macquer. Bernard, on the contrary, found that caoutchouc was scarcely soluble at all in sulphuric ether, which was the ether used by Macquer, and that even nitric ether was but an imperfect solvent. The difference in the results of these two chemists was very singular; both were remarkable for their accuracy, and both were too well acquainted with the subject to be easily misled. The matter was first cleared up by Mr Cavallo. He found that ether, when newly prepared, seldom or never dissolved caoutchouc completely; but if the precaution was taken to wash the ether previously in water, it afterwards dissolved caoutchouc with facility.

When the ether is evaporated, the caoutchouc is obtained unaltered. Caoutchouc, therefore, dissolved in ether, may be employed to make instruments of different kinds, just as the milky juice of the *hævea;* but this method would be a great deal too expensive for common use.

Caoutchouc is soluble in volatile oils; but, in general, when these oils are evaporated, it remains somewhat glutinous, and therefore is scarcely proper for those uses to which, before its solution, it was so admirably adapted.

The acids act but feebly upon caoutchouc. Sulphuric acid, even after a long digestion, only chars it superficially. When treated with nitric acid, there came over azotic gas, carbonic acid gas, prussic acid gas; and oxalic acid is said to be formed. Muriatic acid does not affect it. The other acids have not been tried.

Fabroni has discovered, that rectified petroleum dissolves it, and leaves it unaltered when evaporated.

When exposed to heat it readily melts; but it never afterwards recovers its properties, but continues always of the consistence of tar. It burns very readily with a bright flame, and diffuses a fetid odour. In those countries where it is produced, it is often used by way of candle.

When distilled, it gives out ammonia. It is evident from this, and from the effect of sulphuric and nitric acid upon it, that it is composed of carbon, hydrogen, azote, and oxygen; but the manner in which they are combined is unknown.

Sect. XXVII. *Of Gum Resins.*

This class of vegetable substances has been long distinguished by physicians and apothecaries. It contains many active substances much employed in medicine; and they certainly possess a sufficient number of peculiar properties to entitle them to be ranked apart. Unfortunately these substances have not yet attracted much of the attention of chemists. Their properties and constituents, of course, are but imperfectly ascertained.

They are usually opake, or at least their transparency is inferior to that of the resins. They are always solid, and most commonly brittle, and have sometimes a fatty appearance.

When heated, they do not melt as the resins do; neither are they so combustible. Heat, however, commonly softens them, and causes them to swell. They burn with a flame.

They have almost always a strong smell, which in several instances is alliaceous. Their taste also is often acrid, and always much stronger than that of the resins.

They are partially soluble in water; but the solution is always opake, and usually milky.

Alcohol dissolves only a portion of them. The solution is transparent; but when diluted with water it becomes milky; yet no precipitate falls, nor is any thing obtained by filtering the solution.

Vinegar and wine likewise dissolve them partially; and the solution, like the aqueous, is opaque or milky.

According to Hermbstadt, they are insoluble in sulphuric ether.

The action of alkalies on them has been examined only by Mr Hatchett. All of them tried by that celebrated chemist, dissolved readily in alkaline solutions, when assisted by heat. We may therefore consider them as soluble in alkalies like resins.

Nitric acid acts upon them with energy; converting them first into a brittle mass, and then, with the assistance of heat, dissolving them.

Their specific gravity is usually greater than that of the resins.

Their other properties still continue unknown. They all either exude spontaneously from plants, or are obtained by incisions. At first they seem to be in a liquid state; but they gradually harden when exposed to the air and weather.

The gum resins which have been hitherto applied to any useful purpose are the following:—

1. *Galbanum.* It is obtained from the *bubon galbanum*, a perennial plant, and a native of Africa. When this plant is cut across a little above the root, a milky juice flows out, which soon hardens and constitutes galbanum. It comes to this country from the Levant, in small pieces, composed of tears, agglutinated together, of a yellowish or white colour. Its taste is acrid and bitter, and its smell peculiar. Water, vinegar, and wine, dissolve part of it, but the solution is milky. Alcohol dissolves about three-fifths.

2. *Ammoniac.*—This substance is brought from the East Indies. Nothing certain is known concerning the plant which yields it; though from analogy it has been suspected to be a species of *ferula*. It is in small pieces, agglutinated together, and has a yellowish white colour. Its smell is somewhat like that of galbanum, but more pleasant. Its taste is a nauseous sweet, mixed with bitter. It does not melt. Water dissolves a portion of it; the solution is milky, but gradually lets fall a resinous portion. More than one half is soluble in alcohol. This portion is a resin.

According to the analysis of Braconnot, ammonia is composed of the following ingredients:

70.0	resin
18.4	gum
4.4	glutinous matter
6.0	water
1.2	loss
100.0	

3. *Olibanum.*—This substance is obtained from the *Boswallia thurifera*, and is chiefly collected in India. It is the frankincense of the ancients. It is in transparent brittle masses about the size of a chesnut. Its colour is yellow. It has a bitterish nauseous taste; and when burnt diffuses an agreeable odour. Alcohol dissolves three-fourths of it, and water about three-eighths.

4. *Asafœtida.*—This substance is obtained from the *ferula asafœtida*, a perennial plant, which is a native of Persia. When the plant is about four years old, its roots are dug up and cleaned. Their extremity being then cut off, a milky juice exudes, which is collected. Then another portion is cut off, and more juice exudes. This is continued till the roots are exhausted. The juice thus collected soon hardens and constitutes *asafœtida.* It comes to Europe in small grains of different colours, whitish, reddish, violet, brown. It is pretty hard, but brittle. Its taste is acrid and bitter; its smell strongly alliaceous and fetid. Alcohol dissolves about three-fourths of this substance; and water takes up nearly one-fourth, if applied before the spirit.

5. *Scammony.*—This substance is obtained from the *convolvulus scammonia*, a climbing plant which grows in Syria. The roots, when cut, yield a milky juice. This, when collected and allowed to harden, constitutes scammony. Colour dark grey or black. Smell peculiar and nauseous. Taste bitter and acrid. With water it forms a greenish-coloured opaque liquid. Alcohol dissolves the greatest part of it. It is usually mixed with the expressed juice of the root, and frequently also with other impurities, which alter its appearance. In medicine it operates as a strong cathartic.

6. *Opoponax.*—This substance is obtained from the *pastinaca opoponax*, a plant which is a native of the countries round the Levant. The gum resin, like most others, is obtained by wounding the roots of the plant. The milky juice, when dried in the sun, constitutes the opoponax. It is in lumps of a reddish yellow colour, and white within. Smell peculiar. Taste bitter and acrid. With water it forms a milky solution, and about one-half of it dissolves. Alcohol acts but feebly.

7. *Gamboge* or *Gumgutt.*—This substance is obtained from the *stalagmitis gambogioides*, a tree which grows wild in the East Indies. In Siam it is obtained in drops by wounding the shoots; in Ceylon it exudes from wounds in the bark. It is brought to Europe in large cakes. Its colour is yellow; it is opaque, brittle, and breaks vitreous. It has no smell, and very little taste. With water it forms a yellow turbid liquid. Alcohol dissolves it almost completely; and when mixed with water becomes turbid, unless the solution contains ammonia.

Braconnot analyzed it, and found it composed of one part of a gum which possessed the properties of cherry tree gum, and four parts of a reddish brittle resin, which possessed the characteristic properties of the resins.

8. *Myrrh.*—The plant from which this substance is obtained is unknown. According to Bruce, it belongs to the genus of *mimosa*. It grows in Abyssinia and Arabia. It is in the form of tears. Colour reddish yellow; when pure somewhat transparent, but it is often opake. Odour peculiar. Taste bitter and aromatic. Does not melt when heated, and burns with difficulty.

From the analysis of Braconnot it appears that myrrh is composed of about

23	resin
77	gum
100	

The resin is reddish, has a bitter taste, and the peculiar odour of myrrh. The gum differs in its properties from every other gummy substance hitherto examined. It has a dark brown colour; is at first soluble in water, but by boiling the liquid, or by exposing the gum to heat, it acquires cohesive properties, and becomes insoluble in water. When distilled it yields ammonia, and when dissolved in nitric acid, azotic gas is disengaged.

It deserves attention, that the gum resins, when subjected to destructive distillation, yield all of them a portion of ammonia; a proof that they all contain azote. In this respect they agree with gum and extractive.

SECT. XXVIII. *Of Cotton.*

Cotton is a soft down which envelopes the seeds of various plants, especially the different species of *gossypium*, from which the cotton of commerce is procured. These plants are natives of warm climates; grow wild in Asia, Africa, and America, within the tropics; and are cultivated in the East and West Indies.

Though no correct chemical investigation of the properties of cotton has hitherto been made, yet as its obvious qualities distinguish it sufficiently from every other vegetable substance, we must consider it as a peculiar vegetable principle; and it has been introduced here, in hopes that some person or other will be induced to examine its nature in detail. The following are the particulars at present known.

This substance is in threads differing in length and fineness. No asperities can be discovered on the surface of these threads; but if Lewenhoeck's microscopical observations are to be trusted, they are all triangular, and have three sharp edges. Cotton differs considerably in colour; but when *bleached* it becomes of a fine white.

Cotton is tasteless and destitute of smell. It is completely insoluble in water, alcohol, ether, and oils, and in all the vegetable acids.

The diluted alkaline leys have no perceptible action on cotton; but when very strong they dissolve it, if assisted by a sufficient degree of heat. The new products obtained by this solution have not been examined.

Cotton combines readily with tannin, and forms a yellow or brown compound. Hence the infusion of galls, and other astringent substances, is often used as a mordant for cotton.

Nitric acid decomposes cotton when assisted by heat, and oxalic acid is formed; the other products have not been examined. Sulphuric acid likewise chars it. Oxymuriatic acid gas bleaches it, and probably alters and dissolves it when applied in a concentrated state.

Cotton is extremely combustible, and burns with a clear lively flame. The ashes left behind, according to Neumann, contain some potash. When distilled, it yields a great portion of acidulous water, and a small quantity of oil, but no ammonia.

SECT. XXIX. *Of Suber.*

This name has been introduced into chemistry by Fourcroy, to denote the outer bark of the *quercus suber*, or the common cork; a substance which possesses properties different from all other vegetable bodies.

It is exceedingly light, soft, and elastic; very combustible, burning with a bright white flame, and leaving a light black bulky charcoal; and when distilled, it yields a little ammonia.

When digested in water, a yellowish coloured solution is obtained, seemingly containing extractive, as nearly the same proportion is taken up by alcohol. Sulphuric acid readily chars it. Nitric acid gives it a yellow colour, corrodes, dissolves, and decomposes it; converting it partly into suberic acid, partly into a substance resembling wax, partly into artificial tannin, and partly into a kind of starchy matter.

SECT. XXX. *Of Wood.*

All trees, and most other plants, contain a particular substance, well known by the name of *wood*. If a piece of wood be well dried, and digested, first in a sufficient quantity of water, and then of alcohol, to extract from it all the substances soluble in these liquids, there remains only behind the *woody fibre*.

This substance, which constitutes the basis of wood, is composed of longitudinal fibres, and is easily subdivided into a number of smaller fibres. It is somewhat transparent; is perfectly tasteless; has no smell; and is not altered by exposure to the atmosphere.

It is insoluble in water and in alcohol. The fixed alkalies, when assisted by heat, give it a deep brown colour, render it soft, and decompose it. A weak alkaline solution dissolves it without alteration; and it may be thrown down again by means of an acid. By this property we are enabled to separate wood from most of the other vegetable principles, as few of them are soluble in weak alkaline leys.

When heated, it blackens without melting or frothing up, and exhales a disagreeable acrid fume, and leaves a charcoal which retains exactly the form of the original mass. When distilled in a retort, it yields an acid liquor of a peculiar taste and smell, distinguished by the name of pyrolignous, and formerly considered as a distinct acid; but Fourcroy and Vauquelin have lately ascertained that it is merely the acetic acid combined with an empyreumatic oil.

Thenard and Gay Lussac found the constituents of oak,

Oxygen, . . .	41.78
Carbon, . . .	52.53
Hydrogen . .	5.69
	100

The constituents of beech they found to be

Oxygen, . . .	42.73
Carbon, . . .	51.45
Hydrogen . .	5.82
	100

SECT. XXXI. *Of Alkalies.*

The only alkalies found in plants are potash and soda. Ammonia may indeed be obtained by distilling many vegetable substances, but it is produced during the operation. One or other of these alkalies is found in every plant which has hitherto been examined. The quantity indeed is usually very small. From the experiments of Vauquelin, it is probable that the alkalies are combined in plants with acetic and carbonic acids.

1. Potash is found in almost all plants which grow at a distance from the sea. It may be extracted by burning the vegetable, washing the ashes in water, filtrating the water, and evaporating it to dryness. It is in this manner that all the potash of commerce is procured.

In general, three times as much ashes are obtained from shrubs, and five times as much from herbs, as from trees. Equal weights of the branches of trees produce more ashes than the trunk, and the leaves more than the branches. Herbs arrived at maturity produce more ashes than at any other time. Green vegetables produce more ashes than dry.

2. Soda is found in almost all the plants which grow in the sea, and in many of those which grow on the shore. In general, the quantity of soda which plants contain bears a much greater proportion to their weight than the potash does which is found in inland vegetables. 100 parts of the *salsola soda*, for instance, yield 19.921 of ashes; and these contain 1.992 parts of soda; some of which, however, is combined with muriatic acid. The plants from which the greater part of the soda, or *barilha* as it is called, which is imported from Spain, is extracted, are the *salsola sativa* and *vermiculata*.

SECT. XXXII. *Of Earths.*

The only earths hitherto found in plants are the four following: *lime*, *silica*, *magnesia*, *alumina*.

1. Lime is usually the most abundant of the earths of plants, and the most generally diffused over the vegetable kingdom. Indeed it is a very uncommon thing to find a plant entirely destitute of lime: salsola soda is almost the only one in which we know for certain that this earth does not exist.

2. Silica exists also in many plants, particularly in grasses and equisetums. Mr Davy has ascertained that it forms a part of the epidermis, or outer bark of these plants; and that in some of them almost the whole epidermis is silica.

3. Magnesia does not exist so generally in the vegetable kingdom as the two preceding earths. It has been found, however, in considerable quantities in several sea plants, especially fuci; but the salsola soda contains a greater proportion of magnesia than any plant hitherto examined. Mr Vauquelin found that 100 parts of it contained 17.929 of that earth.

4. Alumina has only been found in very small quantities in plants.

The following Table exhibits the quantity of earths and metallic oxides in grains, obtained by Schræder from 32 ounces of the seeds of the following kinds of corn; wheat (*triticum hybernum*), rye (*secale cereale*), barley (*hordeum vulgare*), oats (*avena sativa*), and likewise from the same quantity of rye straw.

	Wheat.	Rye.	Barley	Oats.	Rye Straw.
Silica	13.2	15.6	66.7	144.2	152
Carbonate of lime . .	12.6	13.4	24.8	33.75	46.2
Carbonate of magnesia	13.4	14.2	25.3	33.9	28.2
Alumina	0.6	1.4	4.2	4.5	3.2
Oxide of manganese .	5.0	3.2	6.7	6.95	6.8
Oxide of Iron . . .	2.5	0.9	3.8	4.5	2.4
	47.3	48.7	131.5	227.8	328.9

Sect. XXXIII. *Of Metals.*

Several metallic substances have also been found in the ashes of vegetables, but their quantity is exceedingly small; so small, indeed, that without very delicate experiments their presence cannot even be detected.

The metals hitherto discovered are iron, which is by far the most common, manganese, and, if we believe some chemists, gold.

1. Iron has been found in many plants; the ashes of salsola contain a considerable quantity of it.

2. Scheele first detected manganese in vegetables. Proust found it in the ashes of the pine, calendula, vine, green oak, and fig-tree.

3 With respect to the minute portion of gold extracted from the ashes of plants by Kunkel, Sage, &c. it is probable that it proceeded rather from the lead which they employed in their processes than from the ashes.

Chap. II. *Of Vegetation.* See the articles Botany, and Vegetable *Physiology.*

Chap. III. *Of the Decomposition of Vegetable Substances.* See the articles Bread, Fermentation, Putrefaction, Vinegar, and Wine.

BOOK V.

OF ANIMALS.

When we compare animals and vegetables together, each in their most perfect state, nothing can be easier than to distinguish them. The plant is confined to a particular spot, and exhibits no mark of consciousness or intelligence: the animal, on the contrary, can remove at pleasure from one place to another, is possessed of consciousness, and a high degree of intelligence. But on approaching the contiguous extremities of the animal and vegetable kingdom, these striking differences gradually disappear; the objects acquire a greater degree of resemblance; and at last approach each other so nearly, that it is scarcely possible to decide whether some of those species which are situated on the very boundary, belong to the animal or vegetable kingdom.

To draw a line of distinction, then, between animals and vegetables, would be a very difficult task: but it is not necessary at present to attempt it; for almost the only animals whose bodies have been hitherto examined with any degree of chemical accuracy, belong to the most perfect classes, and consequently are in no danger of being confounded with plants. Indeed, the greater number of facts which we have to relate apply only to the human body, and to those of a few domestic animals. The task of analysing all animal bodies is immense, and must be the work of ages of indefatigable industry.

This part of the subject naturally divides itself into two Chapters. In the first Chapter, we shall give an account of the different ingredients hitherto found in animals, such of them at least as have been examined with any degree of accuracy; and, in the second, we shall treat of the different members of which animal bodies are composed, which must consist each of various combinations of the ingredients described in the first Chapter.

Chap. I.

Of Animal Substances.

The substances which have been hitherto detected in the animal kingdom, and of which the different parts of animals, as far as these parts have been analysed, are found to be composed, may be arranged under the following heads:

1. Gelatine.
2. Albumen.
3. Mucus.
4. Fibrin.
5. Urea.
6. Saccharine matter.
7. Oils.
8. Resins.
9. Sulphur.
10. Phosphorus.
11. Acids.
12. Alkalies.
13. Earths.
14. Metals.

These shall form the subject of the following Sections.

Sect. I. *Of Gelatine.*

If a piece of the fresh skin of an animal, an ox for instance, after the hair and every impurity is carefully separated, be washed repeatedly in cold water till the liquid ceases to be coloured, or to abstract any thing; if the skin, thus purified, be put into a quantity of pure water, and boiled for some time, part of it will be dissolved. Let the decoction be slowly evaporated till it is reduced to a small quantity, and then put aside to cool. When cold, it will be found to have assumed a solid form, and to resemble precisely that tremulous substance well known to every body under the name of *jelly.* This is the substance called in chemistry *gelatine.* If the evaporation be still farther continued, by exposing the jelly to dry air, it becomes hard, semitransparent, breaks with a glassy fracture, and is, in short, the substance so much employed in different arts under the name of *glue.* Gelatine, then, is precisely the same with glue; only that it must be supposed always free from those impurities with which glue is so often contaminated.

Gelatine is semitransparent, and colourless when pure. Its consistency and hardness vary considerably. The best kinds are very hard, brittle, and break with a glassy fracture. Its taste is insipid, and it has no smell.

When thrown into water it swells very much, but does not readily dissolve; and when taken out, it is soft and gelatinous; but when allowed to dry, it recovers its former appearance. If it be put in this gelatinous state into warm water, it very soon dissolves, and forms a solution of an opal colour, and the more opake according to the quantity of gelatine which it contains. Tremulous gelatine dissolves in a very small portion of hot water; but as the solution cools, it gelatinizes afresh. If this solution, as soon as it assumes the tremulous form, be mixed with cold water and shaken, a complete solution takes place.

Dry gelatine undergoes no change when kept; but in the gelatinous state, or when dissolved in water, it very soon putrefies; an acid makes its appearance in the first place, (probably the acetic,) a fetid odour is exhaled, and afterwards ammonia is formed.

Acids dissolve gelatine with facility, even when diluted, especially when assisted by heat; but we are still ignorant of the changes produced upon it by these agents, except by nitric acid. When this acid is digested on it, a small quantity of azotic gas is disengaged, then abundance of nitrous gas; the gelatine is dissolved, except an oily matter which appears on the surface, and converted partly into oxalic and malic acids.

Alkalies dissolve gelatine with facility, especially when assisted by heat; but the solution does not possess the properties of soap.

None of the earths seem to combine with gelatine; at least they do not precipitate it from its solution in water.

The metals, in their pure state, have no effect upon gelatine; but several of the metallic oxides, when agitated in a solution of gelatine, have the property of depriving the water of the greatest part of that body, with which they form an insoluble compound. Several of the metallic salts likewise precipitate gelatine from water.

Gelatine is insoluble in alcohol. When alcohol is mixed with a solution of gelatine, the mixture becomes milky; but becomes again transparent when agitated, unless the solution be concentrated, and the quantity of alcohol considerable. Gelatine is most probably equally insoluble in ether; though I believe the experiment has not been tried.

When the solution of tannin is dropt into gelatine, a copious white precipitate appears, which soon forms an elastic adhesive mass not unlike vegetable gluten. This precipitate is composed of gelatine and tannin; it soon dries in the open air, and forms a brittle resinous-like substance, insoluble in water, capable of resisting the greater number of chemical agents, and not susceptible of putrefaction.

Gelatine does not, properly speaking, combine with oils, but it renders them miscible with water, and forms a kind of emulsion.

From the effects of different re-agents on gelatine, and from the decomposition which it undergoes when heated, we see that it contains carbon, hydrogen, azote, and oxygen. The phosphate of lime, and the traces of soda, which it always yields, are most likely only held in solution by it. The constituents, according to the experiments of Thenard and Gay Lussac, was as follows:

Carbon,	67.881
Oxygen,	27.207
Hydrogen,	7.914
Azote,	16.998
	100

Sect. II. *Of Albumen.*

The eggs of fowls contain two very different substances: a yellow oily-like matter, called the *yolk;* and a colourless glossy viscid liquid, distinguished by the name of *white*. This last is the substance which chemists have agreed to denominate *albumen*. The white of an egg, however, is not pure albumen. It contains also some mucus, soda, and sulphur: but as albumen is never found perfectly pure, and as no method is known of separating it, without at the same time altering the properties of the albumen, chemists are obliged to examine it while in combination with these bodies.

Albumen dissolves readily in water, and the solution has the property of giving a green colour to vegetable blues, in consequence of the soda which it contains. When albumen is heated to the temperature of 165°, it *coagulates* into a white solid mass; the consistency of which, when other things are equal, depends, in some measure, on the time during which the heat was applied. The coagulated mass has precisely the same weight that it had while fluid. This property of coagulating when heated is characteristic of albumen, and distinguishes it from other bodies.

The taste of coagulated albumen is quite different from that of liquid albumen: its appearance, too, and its properties, are entirely changed; for it is no longer soluble, as before, either in hot or in cold water.

The coagulation of albumen takes place even though air be completely excluded; and even when air is present, there is no absorption of it, nor does albumen in coagulating change its volume. Acids have the property of coagulating albumen, as Scheele ascertained. Alcohol also produces, in some measure, the same effect. *Heat*, then, *acids* and *alcohol*, are the agents which may be employed to coagulate albumen.

It is remarkable, that if albumen be diluted with a sufficient quantity of water, it can no longer be coagulated by any of these agents.

We see, therefore, that albumen ceases to coagulate whenever its particles are separated from each other beyond a certain distance. That no other change is produced, appears evident from this circumstance, that whenever the watery solution of albumen is sufficiently concentrated by evaporation, coagulation takes place, upon the application of the proper agents, precisely as formerly.

It does not appear that the distance of the particles of albumen is changed by coagulation; for coagulated albumen occupies precisely the same sensible space as liquid albumen.

Albumen, then, is capable of existing in two states; the one before it has been coagulated, and the other after it has undergone coagulation. Its properties are very different in each. It will be proper therefore to consider them separately.

Albumen, in its natural state, or uncoagulated, is a glary liquid, having little taste and no smell. When dried spontaneously, or in a low heat, it becomes a brittle transparent glassy-like substance; which, when spread thin upon surfaces, forms a varnish, and is accordingly employed by bookbinders for that purpose. When thus dried, it has a considerable resemblance to gum arabic, to which also its taste is similar. The white of an egg loses about four-fifths of its weight in drying. It is still soluble in water, and forms the same glary liquid as before.

From the experiments of Dr Bostock, it appears, that when one part of this dry albumen is dissolved in nine parts of water, the solution becomes perfectly solid when coagulated by heat; but if the albumen amounts only to $\frac{1}{13}$th of the liquid, then, though coagulation takes place, the liquid does not become perfectly solid, but may be poured from one vessel to another

When one grain of albumen is dissolved in 1000 grains of water, the solution becomes cloudy when heated.

1. Uncoagulated albumen soon putrefies, unless it be dried; in which state it does not undergo any change. It putrefies more readily when dissolved in a large quantity of water, than when concentrated. The smell of the white of egg, allowed to run into putrefaction, resembles that of *pus*.

It is insoluble in alcohol and ether, which immediately coagulate it, unless it be mixed with a very great proportion of water; in which case even acids have no effect.

When acids are poured upon it, coagulation takes place equally; but several of them have the property of dissolving it again when assisted by heat. This at least is the case with sulphuric acid. The solution is of a green colour, and does not soon blacken even when boiled. It is the case also with nitric acid, and probably also with muriatic acid. Nitric acid first disengages some azotic gas; then the albumen is gradually dissolved, nitrous gas emitted, oxalic and malic acids formed, and a thick oily matter makes its appearance on the surface.

None of the earths form insoluble compounds with albumen; in this respect they resemble the alkalies. The case is different with the metallic oxides.

Every metal tried, except cobalt, occasions a precipitate; but no precipitate ever appears when the oxide is held in solution by an alkali or earth. The effect of the metallic salts on albumen forms a striking contrast with their effect on gelatine.

From the experiments of Dr Bostock, it appears that a drop of the saturated solution of oxymuriate of mercury, let fall into water containing $\frac{1}{2000}$th part of its weight of albumen, produces an evident milkiness, and a curdy precipitate falls. It is therefore a very delicate test of the presence of albumen in animal fluids.

If a solution of tannin be poured into an aqueous solution of uncoagulated albumen, it forms with it a very copious yellow precipitate, of the consistence of pitch, and insoluble in water. This precipitate is a combination of tannin and albumen. When dry it is brittle, like overtanned leather, and is not susceptible of putrefaction. This property which albumen has of precipitating with tannin was discovered by Seguin.

The infusion of galls is by no means so delicate a test of the presence of albumen as of gelatine. When an infusion of galls, containing 2½ per cent. of solid matter, and water holding $\frac{1}{1000}$th of albumen in solution are mixed in equal quantities, no effect is produced at first, but after some time a precipitating matter appears, and slowly subsides.

II. When albumen is coagulated either by heat, alcohol, or acids, it is an opake substance, of a pearl white colour, tough, and of a sweetish mucilaginous taste. It is no longer soluble in water, and is not nearly so susceptible of decomposition as uncoagulated albumen. Mr Hatchett kept it for a month under water, and yet it did not become putrid.

When this substance was digested for some hours in water, it gradually softened, and became white and opake like newly coagulated albumen. When water is made to act upon it long, a small portion of it is taken up. The watery liquid is not precipitated by the infusion of tan; but nitromuriate of tin occasions a faint cloud.

According to Scheele, the mineral acids, when greatly diluted with water, dissolve a portion of coagulated albumen, which is thrown down again by the same acids concentrated.

When coagulated albumen is steeped in diluted nitric acid, the acid in about four weeks begins to acquire a yellow tinge, which becomes gradually deeper; but the albumen, though it becomes more opake, is not dissolved. The yellow acid, when saturated with ammonia, becomes of a deep orange colour, but does not let fall any precipitate. When the albumen, thus treated, is immersed in ammonia, the liquid assumes a deep orange colour, inclining to blood-red. The albumen is slowly dissolved, and the solution has a deep yellowish brown colour. If the albumen, after being steeped in nitric acid, be washed and then boiled in water, it is dissolved, and forms a pale yellow liquid, which gelatinises when properly concentrated. If the gelatinous mass be again dissolved in boiling water, the solution is precipitated by tan and by nitro-muriate of tin. Hence we see that nitric acid has the property of converting coagulated albumen into gelatine.

Concentrated nitric acid dissolves coagulated albumen with effervescence, especially when assisted by heat. It becomes orange brown when mixed with ammonia, but no precipitate falls.

It is readily dissolved by boiling lixivium of potash, ammonia is disengaged, and an animal soap is formed. This soap, when dissolved in water, and mixed with acetic or muriatic acids, lets fall a precipitate which is of a saponaceous nature. When heated gently, some oil flows from it, and a brownish viscid substance remains. The alkalies, when diluted, and not assisted by heat, act upon it slowly and imperfectly.

These properties indicate sufficiently that coagulated albumen is a very different substance from uncoagulated albumen.

III. From the effects of nitric acid on albumen; and its products, when subjected to destructive distillation, it has been concluded that it consists of carbon, hydrogen, azote, and oxygen.

According to the experiments of Thenard and Gay Lussac, its constituents are as follows:

Carbon, . .	52.883
Oxygen, . .	23.872
Hydrogen, .	7.540
Azote, . . .	15.705
	100

Mr Hatchett has rendered it very probable that it is the first of the soft part of animals that is formed, and that all the other soft parts are formed from it.

Sect. III. *Of Mucus.*

No word in chemistry has been used with less precision than *mucus*. Too many experimenters have made it serve as a common name for every animal substance which cannot be referred to any other class. Dr Bostock, in his excellent papers on the *Analysis of Animal Fluids*, has endeavoured to fix the meaning of the word, by ascertaining the properties of pure mucus. Fourcroy and Vauquelin have lately written an elaborate paper on the same subject.

From Bostock's experiments it appears, that if the solid matter obtained by evaporating saliva to dryness be re-dissolved in water and filtered, the solution will contain very little except mucus. He obtained mucus, also, by macerating an oyster in water, and evaporating the liquid. Mucus, thus obtained, possesses the following properties:

1. It has much the appearance of gum arabic, excepting that, in general, it is rather more opaque; like it, it has little taste, dissolves readily in water, and forms an adhesive solution.

2. When evaporated to dryness, it is transparent, inelastic, and has much the appearance of gum. It is insoluble in water, but dissolves readily in all the acids, though very much diluted.

3. It does not dissolve in alcohol, nor in ether.

4. It does not coagulate when heated; nor when concentrated by evaporation does its solution assume the form of a jelly.

5. It is not precipitated by the oxymuriate of mercury, nor by the infusion of galls.

6. The acetate of lead occasions a copious white pre-

cipitate when dropt into solutions containing mucus; the superacetate produces a much less striking effect.

7. Nitrate of silver likewise occasions a precipitate in solutions containing mucus.

8. When heated, it assumes the appearance of horn, and when distilled it yields the common products of animal substances. According to Fourcroy and Vauquelin, horn, nails, hair, feathers, the epidermis, and the scales which form on the skin, consist chiefly of mucus.

Many of the substances called *mucus* have the property of absorbing oxygen, and of becoming by that means insoluble in water. They resemble vegetable extractive matter in this respect.

Sect. IV. *Fibrin.*

If a quantity of blood, newly drawn from an animal, be allowed to remain at rest for some time, a thick red clot gradually forms in it, and subsides. Separate this clot from the rest of the blood, put it into a linen cloth, and wash it repeatedly in water till it ceases to give out any colour or taste to the liquid; the substance which remains after this process is denominated *fibrin*. It has been long known to physicians under the name of the *fibrous part of the blood*, but has not till lately been accurately described.

It may be procured also from the muscles of animals. Mr Hatchett, to whom we are indebted for a very interesting set of experiments on this substance, cut a quantity of lean beef into small pieces, and macerated it in water for 15 days, changing the water every day, and subjecting the beef to pressure at the same time, in order to squeeze out the water. As the weather was cold, it gave no signs of putrefaction during this process. The shreds of muscle, which amounted to about three pounds, were now boiled for five hours every day, for three weeks, in six quarts of fresh water, which was regularly changed every day. The fibrous part was now pressed, and dried by the heat of a water bath. After this treatment it might be considered as fibrin nearly as pure as it can be obtained.

Fibrin is of a white colour, has no taste nor smell, and is not soluble in water nor in alcohol. When newly extracted from blood, it is soft and elastic, and resembles very much the gluten of vegetables. Its colour deepens very much in drying. That which is extracted from muscle by boiling and maceration has a certain degree of transparency, and is not ductile but brittle. Its colour does not deepen nearly so much as the fibrin from blood.

It undergoes no change though kept exposed to the action of air; neither does it alter speedily though kept covered with water. Mr Hatchett kept a quantity of the fibrin which he had prepared from beef moistened with water during the whole month of April; it acquired a musty but not a putrid smell, neither were the fibres reduced to a pulpy mass. Even when kept two months under water, it neither became putrid, nor was converted into the fatty matter obtained by macerating recent muscle.

When fibrin is exposed to heat, it contracts very suddenly, and moves like a bit of horn, exhaling at the same time the smell of burning feathers. In a stronger heat it melts. When exposed to destructive distillation, it yields water, carbonate of ammonia, a thick heavy fetid oil, traces of acetic acid, carbonic acid, and carbureted hydrogen gas.

Acids dissolve fibrin with considerable facility. Sulphuric acid gives it a deep brown colour; charcoal is precipitated, and acetic acid formed. Muriatic acid dissolves it, and forms with it a green-coloured jelly. The acetic, citric, oxalic, and tartaric acids also dissolve it by the assistance of heat; and the solutions, when concentrated, assume the appearance of jelly. Alkalies precipitate the fibrin from acids in flakes, soluble in hot water, and resembling gelatine in its properties.

Diluted nitric acid occasions the separation of a good deal of azotic gas, as was first observed by Berthollet. Mr Hatchett steeped a quantity of fibrin in nitric acid diluted with thrice its weight of water for 15 days. The acid acquired a yellow tinge, and possessed all the properties of the nitric solution of albumen. The fibrin thus treated, dissolved in boiling water, and when concentrated by evaporation, became a gelatinous mass, soluble in hot water, and precipitated by tan and nitromuriate of tin, and therefore possessing the properties of gelatine. Ammonia dissolves the greater part of the fibrin after it has been altered by nitric acid. The solution is of a deep orange colour, similar to the solution of albumen treated in the same way. Boiling nitric acid dissolves fibrin, except some fatty matter which swims on the surface. The solution resembles that of albumen; except that ammonia throws down a white precipitate, consisting chiefly of oxalate of lime. During the solution, prussic acid comes over, and carbonic acid gas mixed with nitrous gas; a considerable portion of oxalic acid is formed besides the fatty matter which swims.

The alkalies, while diluted, have but little effect upon fibrin; but when concentrated potash or soda is boiled upon it, a complete solution is obtained, of a deep brown colour, possessing the properties of soap. During the solution ammonia is disengaged. When the solution is saturated with muriatic acid, a precipitate is obtained similar to that from animal soap, except that it sooner becomes hard and soapy when exposed to the air.

The earths, as far as is known, have little or no action on fibrin. Neither has the action of the metallic oxides and salts been examined.

Fibrin is insoluble in alcohol, ether, and oils. The effect of other re-agents on it has not been examined.

From the properties above detailed, fibrin appears to be composed of the same constituents as gelatine and albumen; but it contains more carbon and azote, and less oxygen. According to the experiments of Thenard and Gay Lussac, its constituents are as follows:

Carbon	53.360
Oxygen	19.681
Hydrogen	7.021
Azote	19.934
	100

The close resemblance which it bears to albumen, is very obvious from the experiments of Hatchett, just detailed. Nitric acid converts both into *gelatine*, and alkalies convert both into a species of *oil*. Now, as all the soft parts of animals consist of combinations of these three genera, it follows, as Mr Hatchett has observed, that all the soft parts of animals may be either converted into gelatine or animal soap, both substances of the highest importance.

Fibrin exists only in the blood and the muscles of animals; but it is a genus which includes as many species as there are varieties in the muscles of animals; and the great diversity of these substances is well known. The muscles of fish, of fowl, and of quadrupeds, bear scarcely any resemblance to each other.

Sect. V. *Of Urea.*

Urea may be obtained by the following process: Evaporate by a gentle heat a quantity of human urine, voided six or eight hours after a meal, till it be reduced to the consistence of a thick syrup. In this state, when put by to cool, it concretes into a crystalline mass. Pour at different times upon this mass four times its weight of alcohol, and apply a gentle heat; a great part of the mass will be dissolved, and there will remain only a number of saline substances. Pour the alcohol solution into a retort, and distil by the heat of a sand-bath, till the liquid, after boiling some time, is reduced to the consistence of a thick syrup. The whole of the alcohol is now separated, and what remains in the retort crystallizes as it cools. These crystals consist of the substance known by the name of *urea.*

Urea, obtained in this manner, has the form of crystalline plates crossing each other in different directions. Its colour is yellowish white: it has a fetid smell, somewhat resembling that of garlic or arsenic; its taste is strong and acrid, resembling that of ammoniacal salts; it is very viscid and difficult to cut, and has a good deal of resemblance to honey. When exposed to the open air, it very soon attracts moisture, and is converted into a thick brown liquid. It is extremely soluble in water; and during its solution a considerable degree of cold is produced. Alcohol dissolves it with facility, but scarcely in so large a proportion as water. The alcohol solution yields crystals much more readily on evaporation than the solution in water.

When nitric acid is dropt into a concentrated solution of urea in water, a great number of bright pearl-coloured crystals are deposited, composed of urea and nitric acid. No other acid produces this singular effect. The concentrated solution of urea in water is brown, but it becomes yellow when diluted with a large quantity of water. The infusion of nutgalls gives it a yellowish-brown colour, but causes no precipitate; neither does the infusion of tan produce any precipitate.

When heat is applied to urea, it very soon melts, swells up, and evaporates with an insupportably fetid odour. When distilled, there comes over first benzoic acid, then carbonate of ammonia in crystals, some carbureted hydrogen gas, with traces of prussic acid and oil; and there remains behind a large residuum, composed of charcoal, muriate of ammonia, and muriate of soda. The distillation is accompanied with an almost insupportably fetid alliaceous odour.

When the solution of urea in water is kept in a boiling heat, and new water is added as it evaporates, the urea is gradually decomposed, a very great quantity of carbonate of ammonia is disengaged, and at the same time acetic acid is formed, and some charcoal precipitates.

When a solution of urea in water is left to itself for some time, it is gradually decomposed. A froth collects on its surface; air bubbles are emitted, which have a strong disagreeable smell, in which ammonia and acetic acid are distinguishable. The liquid contains a quantity of acetic acid. The decomposition is much more rapid if a little gelatine be added to the solution. In that case more ammonia is disengaged, and the proportion of acetic acid is not so great.

When the solution of urea is mixed with one-fourth of its weight of diluted sulphuric acid, no effervescence takes place; but, on the application of heat, a quantity of oil appears on the surface, which concretes upon cooling; the liquid which comes over into the receiver contains acetic acid, and a quantity of sulphate of ammonia remains in the retort dissolved in the undistilled mass. By repeated distillations, the whole of the urea is converted into acetic acid and ammonia.

When nitric acid is poured upon crystallized urea, a violent effervescence takes place, the mixture frothes, assumes the form of a dark red liquid, great quantities of nitrous gas, azotic gas, and carbonic acid gas, are disengaged. When the effervescence is over, there remains only a concrete white matter, with some drops of reddish liquid. When heat is applied to this residuum, it detonates like nitrate of ammonia.

Muriatic acid dissolves urea, but does not alter it. Oxymuriatic acid gas is absorbed very rapidly by a diluted solution of urea; small whitish flakes appear, which soon become brown, and adhere to the sides of the vessel like a concrete oil. After a considerable quantity of oxymuriatic acid had been absorbed, the solution, left to itself, continued to effervesce exceeding slowly, and to emit carbonic acid and azotic gas. After this effervescence was over, the liquid contained muriate and carbonate of ammonia.

Urea is dissolved very rapidly by a solution of potash or soda, and at the same time a quantity of ammonia is disengaged; the same substance is disengaged when urea is treated with barytes, lime, or even magnesia. Hence it is evident, that this appearance must be ascribed to the muriate of ammonia, with which it is constantly mixed. When pure solid potash is triturated with urea, heat is produced, a great quantity of ammonia is disengaged; the mixture becomes brown, and a substance is deposited, having the appearance of an empyreumatic oil. One part of urea and two of potash, dissolved in four times its weight of water, when distilled, give out a great quantity of ammoniacal water; the residuum contains acetate and carbonate of potash.

When muriate of soda is dissolved in a solution of urea in water, it is obtained by evaporation, not in cubic crystals, its usual form, but in rectangular octahedrons. Muriate of ammonia, on the contrary, which crystallizes naturally in octahedrons, is converted into cubes, by dissolving and crystallizing it in the solution of urea.

Sect. VI. *Of Saccharine Matter.*

Sugar has never been found in animals in every respect similar to the sugar of vegetables; but there are certain animal substances which have so many properties in common with sugar, that they can scarcely be arranged under any other name. These substances are,

1. Sugar of milk.
2. Honey.
3. Sugar of diabetic urine.

1. Sugar of milk may be obtained by the following process: Let fresh whey be evaporated to the consistence of honey, and then allowed to cool; it concretes into a solid mass. Dissolve this mass in water, clarify it with the white of eggs, filter and evaporate to the consistence of a syrup; it deposites, on cooling, a number of brilliant white cubic crystals, which are *sugar of milk.*

When pure, it has a white colour, a sweetish taste, and no smell. Its crystals are semitransparent regular parallelopipeds, terminated by four-sided pyramids. Its specific gravity, at the temperature of 55°, is 1.543. At that temperature it is soluble in seven times its weight of water; but it is perfectly insoluble in alcohol. When burnt, it emits the odour of caromel, and exhibits precisely the appearance of burning sugar. When distilled, it yields the same products as sugar, only the empyreumatic oil obtained has the odour of benzoic acid. When treated with nitric acid, it yields *saclactic* acid. From these experiments, it appears that sugar of milk is specifically different from every kind of vegetable sugar at present known. Its constituents, according to the experiments of Thenard and Gay Lussac, are as follows:

Oxygen,	53.834
Carbon,	38.825
Hydrogen,	7.341
	100

2. Honey is prepared by bees, and perhaps rather belongs to the vegetable than the animal kingdom. It has a white or yellowish colour, a soft and grained consistence, a saccharine and aromatic smell. By distillation it affords an acid phlegm and an oil, and its coal is light and spongy like that of the mucilages of plants. Nitric acid extracts from it oxalic acid, precisely as it does from sugar. It is very soluble in water, with which it forms a syrup, and like sugar passes to the vinous fermentation.

According to Proust, there are two kinds of honey; one always liquid, and the other solid and not deliquescent. They may be separated, he says, by means of alcohol.

3. The urine of persons labouring under the disease known to physicians by the name of *diabetes*, yields, when evaporated, a considerable quantity of matter which possesses properties analogous to sugar.* This seems to have been first observed by Willis. When treated with nitric acid, it yielded the same proportion of oxalic acid as an equal quantity of common sugar would have done, making allowance for the saline substances present. No saclactic acid was formed. Hence it follows, that this substance is not analogous to sugar of milk, but nearer common sugar in its properties. It has been supposed incapable of crystallizing regularly like common sugar. But we have seen it prepared by Dr Wollaston in small grains, having almost exactly the appearance of common white sugar.

Sect. VII. *Of Oils.*

The oily substances found in animals belong all to the class of fixed oils. They differ very much in their consistence, being found in every intermediate state, from spermaceti, which is perfectly solid, to train oil, which is completely liquid. The most important of them are the following:

1. *Spermaceti.*—This peculiar oily substance is found in the cranium of the *physeter macrocephalus*, or spermaceti whale. It is obtained also from some other species. At first it is mixed with some liquid oil, which is separated by means of a woollen bag. The last portions are removed by an alkaline ley, and the spermaceti is afterwards purified by fusion. Thus obtained, it is a beautiful white substance, usually in small scales, very brittle, has scarcely any taste, and but little smell. It is distinguished from all other fatty bodies by the crystalline appearance which it always assumes. It melts, according to the experiments of Bostock, at the temperature of 112°. When sufficiently heated, it may be distilled over without much alteration; but when distilled repeatedly, it loses its solid form, and becomes a liquid oil.

2. *Fat.*—This substance is found abundantly in different parts of animals. When pure, it possesses the properties of the fixed oils. Its consistence varies from *tallow* or *suet*, which is brittle, to *hog's lard*, which is soft and semi-fluid. To obtain fat pure, it is cut in small pieces, well washed in water, and the membranous parts and vessels separated. It is then melted in a shallow vessel along with some water, and kept melted till the water is completely evaporated. Thus purified, it is white, tasteless, and nearly insipid.

3. *Train oil.*—This liquid is extracted from the blubber of the whale, and from other fish. It forms a very important article of commerce, being employed for combustion in lamps, and for other purposes. It is at first thick; but, on standing, a white mucilaginous matter is deposited, and the oil becomes transparent. It is then of a reddish brown colour, and has a disagreeable smell.

4. Though all the oily bodies found in animal substances belong to the class of fixed oils, yet there is a peculiar volatile oil which makes its appearance, and which is doubtless formed during the distillation of different animal bodies. Though this oil has now lost that celebrity which drew the attention of the older chemists to it, yet, as its properties are peculiar, a short account of it will not be improper. It is usually called the *animal oil of Dippel*, because that chemist first drew the attention of chemists to it. It is usually obtained from the gelatinous and albuminous parts of animals. The horns are said to answer best. The product of the first distillation is to be mixed with water, and distilled with a moderate heat; the oil which is first obtained is the animal oil of Dippel.

It is colourless and transparent; its smell is strong and rather aromatic; it is almost as light and as volatile as ether; water dissolves a portion of it; and it changes syrup of violets green, owing, as is supposed, to its containing a little ammonia. The acids all dissolve it, and form with it a kind of imperfect soap. Nitrous acid sets it on fire. It forms with alkalies a soap. Alcohol, ether, and oils, unite with it. When exposed to the air it becomes brown, and loses its transparency. It was formerly used as a specific in fevers.

Sect. VIII. *Of Animal Resins.*

Substances resembling resins are found in different animal bodies, and which, for that reason, may be called *animal resins*. Their properties are somewhat different from the vegetable resins, but they have not been all examined with precision. The following are the most remarkable of these substances.

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* From 1½ lb. of urine voided by a patient of Dr Barton's, I obtained above 2½ oz. of solid saccharine matter;—solution in alcohol rendered it purer, and of a finer crystalline appearance, but did not eradicate its peculiar offensive urinous smell. From another portion of urine from the same patient, I could only obtain a sweet, dark coloured mass, resembling molasses. The urine readily fermented, and yielded alcohol on distillation. The sugar also readily afforded oxalic acid by means of nitric acid. Coxe.

1. *Resin of bile.* This substance may be obtained by the following process: Into thirty-two parts of fresh ox bile pour one part of concentrated muriatic acid. After the mixture has stood for some hours, pass it through a filter, in order to separate a white coagulated substance. Pour the filtrated liquor, which has a fine green colour, into a glass vessel, and evaporate it by a moderate heat. When it has arrived at a certain degree of concentration, a green-coloured substance precipitates. Decant off the clear liquid, and wash the precipitate in a small quantity of pure water. This precipitate is the *basis of bile*, or the *resin of bile*, as it is sometimes called.

The resin of bile is of a dark brown colour; but when spread out upon paper or on wood, it is a fine grass green. Its taste is intensely bitter.

When heated to about 122° it melts; and if the heat be still farther increased, it takes fire and burns with rapidity. It is insoluble in water, but soluble in alcohol; and water precipitates it from that liquid.

It is soluble also in alkalies, and forms with them a compound, which has been compared to a soap. Acids, when sufficiently diluted, precipitate it both from water and alkalies without any change; but if they be concentrated, the precipitate is re-dissolved.

2. *Ambergris.* This substance is found floating on the sea, near the coasts of India, Africa, and Brazil, usually in small pieces, but sometimes in masses of fifty or one hundred pounds weight. Various opinions have been entertained concerning its origin. Some affirmed that it was the concrete juice of a tree; others thought it a bitumen; but it is now considered as pretty well established, that it is a concretion formed in the stomach or intestines of the *physeter macrocephalus*, or spermaceti whale. See AMBERGRIS.

Ambergris, when pure, is a light soft substance which swims on water. Its specific gravity varies from 0.78 to 0.92, according to Brisson. Bouillon La Grange, who has lately published an analysis of it, found its specific gravity from 0.849 to 0.844. Its colour is ash grey, with brownish-yellow and white streaks. It has an agreeable smell, which improves by keeping. Its taste is insipid.

According to Bouillon La Grange, it is composed of

52.7 adipocire.
30.8 resin.
11.1 benzoic acid.
5.4 charcoal.
———
100.0

3. *Castor.* This substance is obtained from the beaver. In each of the inguinal regions of that animal there are two bags, a large and a small. The large one contains the true castor; the small one a substance which has some resemblance to it, but which is in much less estimation. We are indebted to Bouillon La Grange for a set of experiments on it.

Castor is of a yellow colour, and when newly taken from the animal it is nearly fluid. But by exposure to the atmosphere it gradually hardens, becomes darker coloured, and assumes a resinous appearance. Its taste is bitter and acrid, and its odour strong and aromatic.

From the analysis of Bouillon La Grange, we learn that castor contains the following ingredients:

1. Carbonate of potash.
2. Carbonate of lime.
3. Carbonate of ammonia.
4. Iron.
5. Resin.
6. A mucilaginous extractive matter.
7. A volatile oil.

The properties of the resin are analogous to those of the resin of bile.

SECT. IX. *Of Acids.*

The acids which have been discovered ready formed, and constituting a part of animal bodies, are the following:

1. Phosphoric.
2. Sulphuric.
3. Muriatic.
4. Carbonic.
5. Benzoic.
6. Uric.
7. Rosacic.
8. Amniotic.
9. Oxalic.
10. Formic.
11. Acetic.
12. Malic.

1. The phosphoric acid is by far the most abundant of all the acids found in animals. Combined with lime, it constitutes the basis of bone; and the phosphate of lime is found in the muscles, and almost all the solid parts of animals; neither are there many of the fluids from which it is absent. In the blood, phosphoric acid is found combined with oxide of iron; and in the urine it exists in excess, holding phosphate of lime in solution.

2. Sulphuric acid can scarcely be considered as a component part of any of the substances belonging to the human body. It is said, indeed, to occur sometimes in urine combined with soda. It is, however, a very common constituent of the liquid contents of the inferior animals. Thus sulphate of soda is found in the liquor of the amnios of cows, and sulphate of lime occurs usually in the urine of quadrupeds.

3. Muriatic acid occurs in most of the fluid animal substances, and is almost always combined with soda, constituting common salt.

4. Carbonic acid has been detected in fresh human urine by Proust, and it occurs in the urine of horses and cows abundantly, partly combined with lime.

5. Benzoic acid was first discovered in human urine by Scheele; and Fourcroy and Vauquelin have found it abundantly in the urine of cows. Proust has detected it in the blood, the albumen of an egg, in glue, silk, and wool, in the sponge, different species of algæ, and even in mushrooms.

6. Uric or lithic acid was discovered by Scheele in 1776. It is the most common constituent of urinary calculi, and exists also in human urine. That species of calculus which resembles wool in its colour and appearance, is composed entirely of this substance. It was called at first lithic acid; but this name, in consequence of the remarks made by Dr Pearson on its impropriety, has been laid aside, and that of *uric* acid substituted in its place.

7. Rosacic. During intermittent fevers, urine deposites a very copious precipitate, which has been long known to physicians under the name of *lateritious sediment*. This sediment always makes its appearance at the crisis of fevers. In gouty people, the same sediment appears in equal abundance towards the end of a paroxysm of the disease; and if this sediment suddenly disappears, after it has begun to be deposited, a fresh attack may be expected. Scheele considered this sediment as uric acid mixed with some phosphate of lime; and the same opinion has been entertained by other chemists; but Proust affirms, that it consists chiefly of a different sub-

stance, to which he has given the name of *rosacic* acid, from its colour, mixed with a certain proportion of uric acid and phosphate of lime. This rosacic acid, he informs us, is distinguished from the uric by the facility with which it dissolves in hot water, the violet precipitate which it occasions in muriate of gold, and by the little tendency which it has to crystallize. The experiments of Proust have lately been confirmed by those of Vauquelin.

8. Amniotic acid has been lately discovered by Vauquelin and Buniva in the liquor of the amnios of the cow, and may be obtained in white crystals, by evaporating that liquid slowly. Hence they have given it the name of *amniotic acid*. It is of a white and brilliant colour; its taste has a very slight degree of sourness; it redders the tincture of turnsole; it is scarcely soluble in cold water, but very readily in hot water, from which it separates in long needles as the solution cools. It is soluble also in alcohol, especially when assisted by heat.

9. Oxalic acid has hitherto been found only in a few urinary calculi by Vauquelin and Fourcroy.

10. Formic acid has been hitherto found only in the *formica rufa*, or red ant.

11. Acetic. This acid has been detected in urine by Proust. It exists also in the *formica rufa*, or red ant, as has been demonstrated by the experiments of Fourcroy and Vauquelin. It appears also, from the labours of these philosophers and of Thenard, that the acid found in milk is the acetic, disguised a little by holding some salts in solution.

12. Malic acid. This acid has been lately detected by Fourcroy and Vauquelin, in the acid liquid obtained from the *formica rufa*. When this liquid is saturated with lime, if acetate of lead be dropt into the solution, a copious precipitate falls, which is soluble in acetic acid. Fourcroy and Vauquelin exposed the precipitate to the proper trials, and ascertained that it was malate of lead.

SECT. X. *Of Alkalies, Earths and Metals.*

I. All the alkalies have been found in the fluids of animals.

1. Potash is rather uncommon in the human fluids; but it has been detected in the milk of cows, and it has been found abundantly in the urine of quadrupeds.

2. Soda exists in all the fluids, and seems always to be combined with albumen. Phosphate and muriate of soda are also found. It is this alkali which gives animal fluids the property of tinging vegetable blues green.

3. Ammonia has been detected by Proust in urine; and it is formed in abundance during the putrefaction of most animal bodies.

II. The only earths hitherto found in animals are lime, magnesia, and silica.

1. Lime exists in great abundance in all the larger animals. Combined with phosphoric acid, it constitutes the basis of bones, while shells are composed of carbonate of lime. Phosphate of lime is found also in the muscles and other solid parts, and it is held in solution by almost all the fluids.

2. Magnesia has been detected in human urine by Fourcroy and Vauquelin, combined with phosphoric acid and ammonia. It constitutes also sometimes a component part of the urinary calculi.

3. Silica has not hitherto been detected in any of the component parts of animals, except hair; but Fourcroy and Vauquelin found it in urinary calculi.

III. The metals found in animals are two; namely, iron and manganese.

1. Iron combined with phosphoric acid is a constituent part of the blood. Its presence was first ascertained by Menghini, who proved at the same time that it does not exist in the solid parts of animals. It is said to exist also in bile.

2. Manganese has been found in human hair, but scarcely in any other animal substance.

CHAP. II.

Parts of Animals.

THE different substances which compose the bodies of animals may be arranged under the following heads:

1. Bones and shells.
2. Horns and nails.
3. Muscles.
4. Skin.
5. Membranes.
6. Tendons and ligaments.
7. Glands.
8. Brain and nerves.
9. Marrow.
10. Hair and feathers.
11. Silk and similar bodies.

Besides these substances, which constitute the solid parts of the bodies of animals, there are a number of fluids, the most important of which is the *blood*, which pervades every part of the system in all the larger animals. The rest are known by the name of *secretions*, because they are formed, or *secreted*, as the anatomists term it, from the blood. The principal animal secretions are the following:

1. Milk.
2. Eggs.
3. Saliva.
4. Pancreatic juice.
5. Bile.
6. Cerumen.
7. Tears.
8. Liquor of the pericardium.
9. Humours of the eye.
10. Mucus of the nose, &c.
11. Sinovia.
12. Semen.
13. Liquor of the amnios.
14. Poisonous secretions.
15. Air.

Various substances are separated either from the blood or the food, on purpose to be afterwards thrown out of the body as useless or hurtful. These are called *excretions*. The most important of them are,

1. Sweat.
2. Urine.
3. Fæces.

Besides the liquids which are secreted for the different purposes of healthy animals, there are others which make their appearance only during disease, and which may therefore be called *morbid secretions*. The most important of these are the following:

1. Pus.
2. The liquor of dropsy.
3. The liquor of blisters.

To these we must add several solid bodies, which are occasionally formed in different cavities, in consequence of the diseased action of the parts. They may be called *morbid concretions*. The most remarkable of them are the following;

1. Salivary calculi.
2. Concretions in the lungs, liver, brain, &c.
3. Intestinal calculi.
4. Biliary calculi.
5. Urinary calculi.
6. Gouty calculi.

These different substances shall form the subjects of the following Sections:

Sect. I. *Of Bones, Shells, and Crusts.*

By *bones* are meant those hard, solid, well known substances, to which the firmness, shape, and strength of animal bodies are owing; which, in the larger animals, form, as it were, the ground-work upon which all the rest is built. In man, in quadrupeds, and many other animals, the bones are situated below the other parts, and scarcely any of them are exposed to view; but shell-fish and snails have a hard covering on the outside of their bodies, evidently intended for defence. As these coverings, though known by the name of *shells*, are undoubtedly of a bony matter, we shall include them in this Section.

1. *Bones.*

The bones are the most solid parts of animals. Their texture is sometimes dense, at other times cellular and porous, according to the situation of the bone. They are white, of a lamellar structure, and not flexible nor softened by heat. Their specific gravity differs in different parts. That of adults' teeth is 2.2727; the specific gravity of children's teeth is 2.0833.

The component parts of bones are chiefly four; namely, the earthy salts, fat, gelatine, and cartilage.

1. The earthy salts may be obtained either by calcining the bone to whiteness, or by steeping it for a sufficient length of time in acids. In the first case, the salts remain in the state of a brittle white substance; in the second they are dissolved, and may be thrown down by the proper precipitants. These earthy salts are four in number: 1. Phosphate of lime, which constitutes by far the greatest part of the whole. 2. Carbonate of lime. 3. Phosphate of magnesia, lately discovered by Fourcroy and Vauquelin. It occurs in the bones of all the inferior animals examined by these indefatigable chemists, but could not be detected in human bones. 4. Sulphate of lime, detected by Mr Hatchett in a very minute proportion.

2. The proportion of fat contained in bones is various. By breaking bones in small pieces, and boiling them for some time in water, Mr Proust obtained their fat swimming on the surface of the liquid. It weighed, he says, one-fourth of the weight of the bones employed. This proportion appears excessive, and can scarcely be accounted for, without supposing that the fat still retained water.

3. The gelatine is separated by the same means as the fat, by breaking the bones in pieces and boiling them long enough in water. The water dissolves the gelatine, and gelatinizes when sufficiently concentrated. Hence the importance of bones in making portable soups, the basis of which is concrete gelatine, and likewise in making glue. By this process, Proust obtained from powdered bones about one-sixteenth of their weight of gelatine.

4. When bones are deprived of their gelatine by boiling them in water, and of their earthy salts by steeping them in diluted acids, there remains a soft white elastic substance, possessing the figure of the bones, and known by the name of *cartilage*. From the experiments of Hatchett, it appears that this substance has the properties of coagulated albumen. Like that substance, it becomes brittle and semitransparent when dried, is readily soluble in hot nitric acid, is converted into gelatine by the action of diluted nitric acid; for it is soluble in hot water, and gelatinises on cooling, and ammonia dissolves it and assumes a deep orange colour.

Ox bones, according to the analysis of Fourcroy and Vauquelin, are composed of

51.0	solid gelatine.
37.7	phosphate of lime.
10.0	carbonate of lime.
1.3	phosphate of magnesia.
100.0	

From the calcined bones of horses and sheep, fowls, and fishes, they extracted about one-thirtysixth part of phosphate of magnesia. More lately, these eminent chemists detected the same constituents in human bones.

The only bone hitherto observed altogether destitute of cartilage is the enamel of the teeth. When the raspings of bones are steeped in diluted acids, the cartilage alone remains undissolved. Now, when the raspings of enamel are treated in this manner, Mr Hatchett observed, that the whole was dissolved without any residuum whatever. If we believe Fourcroy and Vauquelin, the enamel of teeth is composed of

72.9	phosphate of lime.
27.1	gelatine and water.
100.0	

But the most complete analysis of teeth has been made by Mr Pepys, and his results agree exactly with those of Hatchett. He found the enamel of the teeth composed of

78	phosphate of lime.
6	carbonate of lime.
16	loss and water.
100	

2. *Shells.*

Under the name of *shells* we include all the bony coverings of the different species of shell fish. Egg shells, also, from the similarity of their texture, belong to the same head. For almost all the knowledge of these substances that we possess, we are indebted to the late important dissertations of Mr Hatchett. A few detached facts, indeed, had been observed by other chemists; but his experiments gave us a systematic view of the constituents of the whole class.

Shells, like bones, consist of calcareous salts united to a soft animal matter; but in them the lime is united chiefly to carbonic acid, whereas in bones it is united to phosphoric acid. In shells, the predominating ingredient is carbonate of lime; whereas in bones, it is phosphate of lime. This constitutes the characteristic difference in their composition.

Mr Hatchett has divided shells into two classes. The first are usually of a compact texture, resemble porcelain, and have an enamelled surface, often finely variegated. The shells belonging to this class have been distinguished by the name of *porcelaneous shells*. To this class belong the various species of *voluta*, *cypræa*, &c. The shells belonging to the second class are usually covered with a strong epidermis, below which lies the shell in layers, and composed entirely of the substance well known by the name of *mother-of-pearl*. They have been distinguished by the name of *mother-of-pearl shells*. The *shell* of the *fresh water muscle*, the *haliotis iris*, the *turbo olearius*, are examples of such shells. The shells of the first of these classes contain a very small portion of soft animal matter; those of the second contain a very large portion. Hence we see that they are extremely different in their composition.

1. Porcelaneous shells, when exposed to a red heat, crackle and lose the colour of their enamelled surface. They emit no smoke or smell; their figure continues unaltered, their colour becomes opake white, tinged partially with pale grey. They dissolve when fresh with effervescence in acids, and without leaving any residue; but if they have been burnt, there remains always a little charcoal. The solution is transparent, gives no precipitate with ammonia or acetate of lead; of course it contains no sensible portion of phosphate or sulphate of lime. Carbonate of ammonia throws down an abundant precipitate of carbonate of lime. Porcelaneous shells, then, consist of carbonate of lime cemented together by a small portion of an animal matter, which is soluble in acids, and therefore resembles gelatine.

2. Mother-of-pearl shells, when exposed to a red heat, crackle, blacken, and emit a strong fetid odour. They exfoliate, and become partly dark grey, partly a fine white. When immersed in acids they effervesce at first strongly; but gradually more and more feebly, till at last the emission of air-bubbles is scarcely perceptible. The acids take up only lime, and leave a number of thin membranous substances, which still retain the form of the shell. From Mr Hatchett's experiments we learn, that these membranes have the properties of coagulated albumen. Mother-of-pearl shells, then, are composed of alternate layers of coagulated albumen, and carbonate of lime, beginning with the epidermis, and ending with the last formed membrane.

Pearl, a well known globular concretion which is formed in some of these shells, resembles them exactly in its structure and composition. It is a beautiful substance, of a bluish white colour, iridescent, and brilliant. It is composed of concentric and alternate coats of thin membrane and carbonate of lime. Their iridescence is obviously the consequence of the lamellated structure.

3. *Crusts.*

By crusts we understand those bony coverings of which the whole external surface of crabs, lobsters, and other similar sea animals are composed. Mr Hatchett found them composed of three ingredients: 1. A cartilaginous substance, possessing the properties of coagulated albumen; 2. Carbonate of lime; 3. Phosphate of lime. By the presence of this last substance they are essentially distinguished from shells; and by the great excess of carbonate of lime above the phosphate, they are equally distinguished from bones. Thus the crusts lie intermediate between bones and shells, partaking of the properties and constitution of each. The shells of the eggs of fowls must be referred likewise to the class of crusts, since they contain both phosphate and carbonate of lime. The animal cement in them, however, is much smaller in quantity. From the experiments of Berniard and Hatchett, it is extremely probable that the shells of snails are composed likewise of the same ingredients, phosphate of lime having been detected in them by these chemists.

SECT. II. *Of Horns, Nails, and Scales.*

In the last Section we treated of those hard parts of animals which were inflexible and incapable of being softened by heat, and which contained a great portion of calcareous salts; but there is another set of hard parts which possess considerable elasticity, which are softened by heat, and which contain but a very small portion of calcareous matter. This set comprehends the substances well known under the names of *horn*, *nails*, and *scales*.

1. *Horns* are well known substances that are attached to the foreheads of oxen, sheep, and various other animals. They are not very hard, as they may be easily cut with a knife or rasped with a file; but they are so tough, as not to be capable of being pounded in a mortar. When in thin plates, they have a degree of transparency, and have been sometimes substituted for glass in windows. When heated sufficiently they become very soft and flexible, so that their shape may be altered considerably. Hence they may be gradually squeezed into a mould, and wrought into various forms, as is well known. When strongly heated in a Papin's digester, they are said to be converted into a gelatinous mass, which possesses the properties of gelatine.

The quantity of earthy matter which they contain is exceedingly small. Mr Hatchett burnt 500 grains of ox horn. The residuum was only 1.5 grain, and not the half of this was phosphate of lime. Seventy-eight grains of the horn of the chamois left only 0.5 of residue, of which less than the half was phosphate of lime. They consist chiefly of a membranous substance, which possesses the properties of coagulated albumen; and probably they contain also a little gelatine.

2. The *nails*, which cover the extremities of the fingers, are attached to the epidermis, and come off along with it. Mr Hatchett has ascertained that they are composed chiefly of a membranous substance, which possesses the properties of coagulated albumen. They seem to contain also a little phosphate of lime. Water softens, but does not dissolve them; but they are readily dissolved and decomposed by concentrated acids and alkalies. Hence it appears that nails agree with horn in their nature and composition. Under the head of nails must be comprehended the talons and claws of the inferior animals, and likewise their hoofs, which differ in no respect from horn.

3. *Scales* of animals are of two kinds; some, as those of serpents and other amphibious animals, have a striking resemblance to horn; while those of fish bear a greater resemblance to mother-of-pearl. The composition of these two kinds of shells is very different.

The scales of fish are composed of different membranous laminæ. When immersed for four or five hours in nitric acid, they become transparent, and perfectly membranaceous. The acid, when saturated with ammonia, gives a copious precipitate of phosphate of lime. Hence they are composed of alternate layers of membrane and phosphate of lime. To this structure they owe their brilliancy. Mr Hatchett found the spicula of the shark's skin to be similar in its composition, but the skin itself yielded no phosphate of lime.

The horny scales of serpents, on the other hand, are composed alone of a horny membrane, and are destitute of phosphate of lime. They yielded, when boiled, but slight traces of gelatine; the horn-like crusts which cover certain insects and other animals, appear, from Mr Hatchett's experiments, to be nearly similar in their composition and nature.

SECT. III. *Of the Muscles of Animals.*

After the hard parts of animals have been examined, it remains for us to consider the composition of the *soft* parts. Of these, the muscles naturally claim our attention in the first place, as being the most important.

The muscular parts of animals are known, in common language, by the name of *flesh*. They constitute a considerable portion of the food of man.

Muscular flesh is composed of a great number of fibres or threads, commonly of a reddish or whitish colour; but its appearance is too well known to require any description. Hitherto it has not been subjected to any accurate chemical analysis.

When a muscle is cut in small pieces, and well washed with water, the blood and other liquids contained in it are separated, and part of the muscular substance also is dissolved. The muscle, by this process, is converted into a white fibrous substance, still retaining the form of the original body. The water assumes the colour which results from mixing water with some blood. When heated it coagulates; brown flakes swim on the surface, consisting of albumen combined with the colouring matter of the blood: some fibrin likewise precipitates. If the evaporation be continued, more albumen precipitates, and at last the whole assumes the form of a jelly. When evaporated to dryness, and treated with alcohol, the gelatine thus formed, together with a little phosphate of soda and of ammonia, remains undissolved; but the alcohol dissolves a peculiar *extractive* matter, first observed by Thouvenel. This matter may be obtained by evaporating the alcohol to dryness. It has a reddish brown colour, a strong acrid taste, and aromatic odour.

If the muscle, after being thus treated with cold water, be boiled for a sufficient time in water, an additional portion of the same substances is separated from it. Some albumen collects on the surface in the form of scum, accompanied with some melted fat. The water, when sufficiently concentrated by evaporation, assumes the form of a jelly. When evaporated to dryness, and treated with alcohol, the gelatine and phosphoric salts remain, while the extractive matter of Thouvenel is dissolved, and may be obtained by evaporating to dryness.

The muscle, thus treated with water, is left in the state of grey fibres, insoluble in water, and becoming brittle when dry. This substance possesses all the properties of *fibrin*.

From these facts, ascertained by Thouvenel and Fourcroy, it appears that the muscles are composed chiefly of fibrin, to which they owe their fibrous structure and their form, and that they contain also,

1. Albumen.
2. Gelatine.
3. Extractive.
4. Phosphate of soda.
5. Phosphate of ammonia.
6. Phosph. of lime and carb. of do.

For the discovery of the last ingredients we are indebted to Mr Hatchett, who found that 500 parts of beef muscle left, after combustion, a residuum of 25.6 parts, consisting chiefly of these salts.

The muscles of different animals differ exceedingly from each other in their appearance and properties, at least as articles of food; but we know little of their chemical differences. The observations of Thouvenel alone were directed to that object, and they are imperfect. The flesh of the *ox* contains, according to him, the greatest quantity of insoluble matter, and leaves the greatest residuum when dried; the flesh of the *calf* is more aqueous and mucous: the land and water *turtle* yields more matter to water than the muscle of the ox; but Thouvenel ascribes the difference to foreign bodies, as ligaments, &c. mixed with the muscle of the turtle: *snails* yield to water a quantity of matter intermediate between that given by beef and veal; with them the muscles of *frogs*, *cray fish*, and *vipers*, agree nearly in this respect; but the muscles of fresh water fish, notwithstanding their softness, yield a considerably smaller proportion.

Sect. IV. *Of the Skin.*

The skin is that strong thick covering which envelopes the whole external surface of animals. It is composed chiefly of two parts: a thin white elastic layer on the outside, which is called *epidermis* or *cuticle;* and a much thicker layer, composed of a great many fibres closely interwoven, and disposed in different directions; this is called the *cutis*, or *true skin*. The *epidermis* is that part of the skin which is raised in blisters.

1. The epidermis is easily separated from the cutis by maceration in hot water. It possesses a very great degree of elasticity.

It is totally insoluble in water and in alcohol. Pure fixed alkalies dissolve it completely, as does lime likewise, though slowly. Sulphuric and muriatic acids do not dissolve it, at least they leave no sensible action on it for a considerable time; but nitric acid soon deprives it of its elasticity, and causes it to fall to pieces.

If the cuticle be tinged with nitric acid, the application of ammonia to it is well known to give it instantaneously a deep orange colour. Now, as Hatchett has shown that this change is also produced upon coagulated albumen in the same circumstances, and as the epidermis resembles that substance in all the properties above detailed, it can scarcely be doubted that it is any thing else than a peculiar modification of coagulated albumen.

2. The cutis is a thick dense membrane, composed of fibres interwoven like the texture of a hat. When it is macerated for some hours in water, and agitation and pressure are employed to accelerate the effect, the blood, and all the extraneous matter with which it was loaded, are separated from it, but its texture remains unaltered. On evaporating the water employed, a small quantity of gelatine may be obtained. No subsequent maceration in cold water has any farther effect. When distilled, it yields the same products as fibrin. The concentrated alkalies dissolve it, converting it into oil and ammonia. Weak acids soften it, render it transparent, and at last dissolve it. Nitric acid converts it into oxalic acid and fat, while, at the same time, azotic gas and prussic acid are emitted. When heated it contracts, and then swells, exhales a fetid odour, and leaves a dense charcoal, difficult to incinerate. By spontaneous decomposition in water or moist earth, it is converted into a fatty matter and into ammonia, which compose a kind of soap. When allowed to remain long in water, it softens and putrefies, being converted into a kind of jelly. When long boiled in water it becomes gelatinous, and dissolves completely, constituting a viscid liquor, which, by proper evaporation, is converted into glue. Hence the cutis of animals is commonly employed in the manufacture of glue.

From these facts, the cutis appears to be a peculiar modification of gelatine, enabled to resist the action of water, partly by the compactness of its texture, and partly by the viscidity of the gelatine of which it is formed; for those skins which dissolve most readily in boiling water afford the worst glue. Mr Hatchett has observed that the viscidity of the gelatine obtained from skins is nearly inversely as their flexibility, the supplest hides always yielding the weakest glue; but this glue is very soon obtained from them by hot water. The skin of the eel is very flexible, and affords very readily a great proportion of gelatine. The skin of the shark also readily yields abundance of gelatine; and the same remark applies to the skins of the hare, rabbit, calf, and ox; the difficulty of obtaining the glue, and its goodness, always increasing with the toughness of the hide The hide of the rhinoceros, which is exceedingly strong and tough, far surpasses the rest in the difficulty of solution, and in the goodness of its glue. When skins are boiled, they gradually swell and assume the appearance of horn: then they dissolve slowly.

3. As to the *rete mucosum*, or the mucous substance, situated between the cutis vera and epidermis, its composition cannot be determined with precision, because its quantity is too small to admit of examination. It is known that the black colour of negroes depends upon a black pigment, situated in this substance. Oxymuriatic acid deprives it of its black colour, and renders it yellow. A negro, by keeping his feet for some time in water impregnated with that acid, deprived it of its colour, and rendered it nearly white; but in a few days the black colour returned again with its former intensity. This experiment was first made by Dr Beddoes on the fingers of a negro.

SECT. V. *Of Membranes, Tendons, Ligaments, and Glands.*

These substances have not hitherto been subjected to a rigid chemical analysis. But from the properties which have been observed, they appear to have a closer resemblance to the skin than to any other animal substance.

1. The membranes are thin semitransparent bodies, which envelope certain parts of the body, especially the viscera; such as, the dura and pia mater, the plura, the peritoneum, the periosteum, &c. These substances are soft and pliable; when macerated in water, they swell, and become somewhat pulpy; and by continued decoction in hot water they are almost completely dissolved, and the solution concretes into gelatine. They are convertible, of course, into the same substance as the cutis by decoction; hence we must consider their composition as similar. Like hides, they may also be tanned and converted into leather. From the experiments of Mr Hatchett, it appears that they contain no phosphate of lime as a constituent part, and scarcely any saline ingredients; for when calcined, they leave but a very inconsiderable residuum. Thus 250 grains of hog's bladder left only 0.02 grain of residuum.

2. The tendons are strong, pearl-coloured, brilliant bodies, which terminate the muscles, and attach them to the bones, and are known in common language by the name of *sinews*. When boiled, they assume the form of a semitransparent gelatinous substance, of a pleasant taste, well known in boiled meat. If the decoction be continued, they dissolve completely, and are converted into gelatine. From these facts we are authorised to conclude, that the composition of the tendons is similar to that of the membranes and cutis.

3. The ligaments are strong bands which bind the bones together at the different joints: they are fibrous substances, very dense and strong, and somewhat elastic. When boiled, they yield a portion of gelatine, but they resist the action of water with great obstinacy, and after a great deal of boiling retain their form, and even their strength. The ligaments, then, differ essentially from the two last species. How far they resemble coagulated albumen, remains to be ascertained. It is not unlikely that they will form a genus apart.

4. The glands are a set of bodies, employed to form or to alter the different liquids which are employed for different purposes in the animal body. There are two sets of them: the *conglobate*, which are small, scattered in the course of the lymphatics; and the *conglomerate*, such as the liver, kidneys, &c. Fourcroy supposes the first of these to be composed of gelatine; but this is not very probable. The structure of the large glands has been examined by anatomists with great care; but we are still ignorant of their composition. Indeed, the present state of chemistry scarcely admits of an accurate analysis of these complicated bodies.

SECT. VI. *Of the Brain and Nerves.*

The brain and nerves are the instruments of sensation, and even of motion; for an animal loses the power of moving a part the instant that the nerves which enter it are cut.

The brain and nerves have a strong resemblance to each other; and it is probable that they agree also in their composition. But hitherto no attempt has been made to analyze the nerves. The only chemists who have examined the nature of *brain* are Mr Thouret and Mr Fourcroy.

The brain consists of two substances, which differ from each other somewhat in colour, but which, in other respects, seem to be of the same nature. The outermost matter, having some small resemblance in colour to wood ashes, has been called the *cineritious* part; the innermost has been called the *medullary* part.

Brain has a soft feel, not unlike that of soap; its texture appears to be very close; its specific gravity is greater than that of water.

When brain is triturated in a mortar with diluted sulphuric acid, part is dissolved; the rest may be separated by filtration in the form of a coagulum. The acid liquor is colourless. By evaporation, the liquid becomes black, sulphurous acid is exhaled, and crystals appear; and when evaporated to dryness, a black mass remains behind. When this mass is diluted with water, a quantity of charcoal separates, and the water remains clear: The brain is completely decomposed, a quantity of ammonia combines with the acid, and forms sulphate of ammonia, while charcoal is precipitated. The water, by evaporation and treatment with alcohol, yields sulphates of ammonia and lime, phosphoric acid, and phosphates of soda and ammonia. Brain, therefore, contains

Phosphate of lime,
Phosphate of soda,
Phosphate of ammonia.

Traces also of sulphate of lime can be discovered in it. The quantity of these salts is very small; altogether they do not amount to $\frac{1}{130}$th part.

Diluted nitric acid, when triturated with brain, likewise dissolves a part, and coagulates the rest. The solution is transparent. When evaporated till the acid becomes concentrated, carbonic acid gas and nitrous gas are disengaged; an effervescence takes place, white fumes appear, an immense quantity of ammonia is disengaged, a bulky charcoal remains, mixed with a considerable quantity of oxalic acid.

When brain is gradually evaporated to dryness by the heat of a water bath, a portion of transparent liquid separates at first from the rest, and the residuum, when nearly dry, acquires a brown colour; its weight amounts to about one-fourth of the fresh brain. It may still be formed into an emulsion with water, but very soon separates again spontaneously.

When alcohol is repeatedly boiled upon this dried residuum, till it ceases to have any more action, it dissolves about five-eighths of the whole. When this alcohol cools, it deposites a yellowish white substance, composed of brilliant plates. When kneaded together by the fingers, it assumes the appearance of a ductile paste: at the temperature of boiling water it becomes soft, and when the heat is increased it blackens, exhales empyreumatic and ammoniacal fumes, and leaves behind it a charry matter. When the alcohol is evaporated, it deposites a yellowish black matter, which reddens paper tinged with turnsole, and readily diffuses itself through water.

Pure concentrated potash dissolves brain, disengaging a great quantity of ammonia.

SECT. VII. *Marrow.*

The hollows of the long bones are in living animals filled with a peculiar species of fat matter, to which the name of *marrow* has been given. In some bones this matter is a good deal mixed with blood, and has a red colour; in others, as the thigh bones, it is purer, and has a yellow colour. Various experiments on this matter were made by the older chemists, showing it to be analogous to animal fats, and pointing out some of its peculiarities. Berzelius has lately examined it in detail, and published the results of his experiments. The marrow on which his trials were made was obtained from the thigh bone of an ox.

Marrow, freed from its impurities, has a white colour with a shade of blue; its taste is insipid and rather sweetish. It softens by the heat of the hand, and melts when heated to 113°. When cooled slowly, it crystallizes in sphericles like olive oil. It burns with a flame like tallow. When distilled it gives first a transparent fluid yellowish oil, accompanied by carbonic acid gas, water, and heavy inflammable air. Afterwards there comes over a white solid oil, accompanied by a less copious evolution of gaseous bodies, and which does not become dark coloured, as happens when tallow is distilled. This had already been observed by Neumann. This solid oil has a disagreeable smell, amounts to 0.8 of the marrow distilled, reddens vegetable blues, and when boiled in water gives out a portion of sebacic acid, which Berzelius considers as benzoic acid.

The empyreumatic oil combines readily with alkalies and their carbonates. With the latter it forms a snow white soap, insoluble in water, though it increases in bulk when placed in contact with that liquid. It combines also with the earths, and forms soaps likewise insoluble in water.

The water which comes over during the distillation of marrow is colourless, has a fetid and sour smell, and an empyreumatic taste. It contains a little acetic acid, empyreumatic oil, and probably benzoic acid; but exhibits no traces of ammonia.

The gaseous products amount to one-tenth of the marrow distilled. They contain no sulphur nor phosphorus, and consist of carbonic acid and heavy inflammable air, which burns with a white flame, and seems to contain oil in solution.

The charry matter in the retort amounts to 0.05 of the marrow distilled. It is dark brown, heavy, and brilliant. It is incinerated with difficulty, and leaves an ash, consisting of phosphate of lime, carbonate of lime, and some soda.

Marrow combines with alkalies and forms soap. Boiling alcohol and ether dissolve a small portion of it, which precipitates again as soon as the solution cools.

Marrow, from the thigh bone of an ox, was found, by Berzelius, to be composed of the following substances:

Pure marrow	0.96
Skins and blood-vessels	0.01
Albumen Gelatine Extractive Peculiar matter Water	0.03
	1.00

From the preceding detail, it appears, that pure marrow is a species of fixed oil, possessing peculiar properties, and approaching somewhat to butter in its nature.

SECT. VIII. *Of Hair and Feathers.*

These substances cover different parts of animals, and are obviously intended by nature to protect them from the cold. For this, their softness and pliability, and the slowness with which they conduct heat, render them peculiarly proper.

1. *Hair* is usually distinguished into various kinds, according to its size and appearance. The strongest and stiffest of all is called *bristle;* of this kind is the hair on the backs of hogs. When remarkably fine, soft, and pliable, it is called *wool;* and the finest of all is known by the name of *down.* But all these varieties resemble one another very closely in their composition.

Vauquelin has lately published a curious set of experiments on the analysis of human hair of various colours. Though hair is insoluble in boiling water, he obtained a solution by raising the temperature of the liquid in a Papin's digester. If the heat thus produced was too great, the hair was decomposed, and ammonia, carbonic acid, and an empyreumatic oil, formed. Sulphureted hydrogen is always evolved, and its quantity increases with the heat. When hair is thus dissolved in water heated above the boiling point, the solution contains a kind of bituminous oil, which is deposited very slowly. This oil was black when the hair dissolved was black, but yellowish red when red hair was employed.

When the solution is filtered to get rid of this oil, the liquid which passes through is nearly colourless. Copious precipitates are formed in it by the infusion of nutgalls and oxymuriatic acid. Silver is blackened by it, and acetate of lead precipitated brown. Acids render it turbid, but the precipitate is re-dissolved, by adding these liquids in excess. Though very much concentrated by evaporation, it does not concrete into a jelly.

Water containing only four per cent. of potash dissolves hair, while hydrosulphuret of ammonia is evolved.

If the hair be black, a thick dark-coloured oil, with some sulphur and iron, remains undissolved; if the hair be red, there remains a yellow oil, with some sulphur and an atom or two of iron. When acids are dropt into this solution, they throw down a white matter soluble in an excess of acid.

Sulphuric and muriatic acids become red when first poured on hair, and gradually dissolve it. Nitric acid turns hair yellow and dissolves it, while an oil separates, which is red or black according to the colour of the hair dissolved. The solution yields a great deal of oxalic acid, and contains, besides, bitter principle, iron, and sulphuric acid. Oxymuriatic acid first whitens hair, and then reduces it to a substance of the consistence of turpentine, and partly soluble in alcohol.

When alcohol is digested on black hair, it extracts from it two kinds of oil. The first, which is white, subsides in white shining scales as the liquor cools; the second is obtained by evaporating the alcohol. It has a greyish green colour, and at last becomes solid. From red hair alcohol likewise separates two oils; the first white as from black hair, and the other as red as blood. When the red hair is deprived of this oil, it becomes of a chesnut colour. Hence its red colour is obviously owing to the red oil.

When hair is incinerated, it yields iron and manganese, phosphate, sulphate, and carbonate of lime, muriate of soda, and a considerable portion of silica. The ashes of red hair contain less iron and manganese: those of white hair still less; but in them we find magnesia, which is wanting in the other varieties of hair. The ashes of hair do not exceed 0.015 of the hair.

From the preceding experiments of Vauquelin, we learn that black hair is composed of the nine following substances:

1. An animal matter, constituting the greatest part.
2. A white solid oil, small in quantity.
3. A greyish green oil, more abundant.
4. Iron; state unknown.
5. Oxide of manganese.
6. Phosphate of lime.
7. Carbonate of lime, very scanty.
8. Silica.
9. Sulphur.

The colouring matter of hair appears from Vauquelin's experiments to be an oil. The oil is blackish green in black hair, red in red hair, and white in white hair. Vauquelin supposes that sulphureted iron contributes to the colour of dark hair; and ascribes to the presence of an excess of sulphur the property which white and red hair have, of becoming black with the oxides of the white metals. The sudden change of colour in hair from grief, he thinks, is owing to the evolution of an acid.

2. *Feathers* seem to possess nearly the same properties with hair. Mr Hatchett has ascertained that the quill is composed chiefly of coagulated albumen. Though feathers were boiled for a long time in water, Mr Hatchett could observe no traces of gelatine.

Having given the preceding account of the solids which compose animal bodies, we proceed next to the fluid which circulates through living bodies, namely *blood*; and to the various *secretions* formed from the blood, either in order to answer some important purpose to the animal, or to be evacuated as useless, that the blood thus purified may be more proper for answering the ends for which it was destined. Many of these substances have been examined with more care by chemists than the animal solids.

SECT. IX. *Of Blood.*

Blood is a well known fluid, which circulates in the veins and arteries of the more perfect animals. It is of a red colour, has a considerable degree of consistency, and an unctuous feel, as if it contained a quantity of soap. Its taste is slightly saline, and it has a peculiar smell.

The specific gravity of human blood is, at a medium, 1.0527.

When blood, after being drawn from an animal, is allowed to remain for some time at rest, it very soon coagulates into a solid mass of the consistence of curdled milk. This mass gradually separates into two parts; one of which is fluid, and is called *serum*; the other, the coagulum, has been called *cruor*, because it alone retains the red colour which distinguishes blood. This separation is very similar to the separation of curdled milk into curds and whey.

1. The serum is of a light greenish yellow colour; it has the taste, smell, and feel of the blood, but its consistence is not so great. Its mean specific gravity is about 1.0287. It converts syrup of violets to a green, and therefore contains an alkali. On examination, Rouelle found that it owes this property to a portion of soda. When heated to the temperature of 156°, the serum coagulates, as Harvey first discovered. It coagulates also when boiling water is mixed with it; but if serum be mixed with six parts of cold water, it does not coagulate by heat. When thus coagulated, it has a greyish white colour, and is not unlike the boiled white of an egg. If the coagulum be cut into small pieces, a muddy fluid may be squeezed from it, which has been termed the *serosity*. After the separation of this fluid, if the residuum be carefully washed in boiling water and examined, it will be found to possess all the properties of coagulated *albumen*. The serum, therefore, contains a considerable proportion of albumen. Hence its coagulation by heat, and the other phenomena which albumen usually exhibits.

If the coagulated serum be heated in a silver vessel, the surface of the silver becomes black, being converted into a sulphuret. Hence it is evident, that it contains sulphur; and Proust has ascertained, that it is combined with ammonia in the state of a hydrosulphuret.

If serum be mixed with twice its weight of water, and, after coagulation by heat, the albumen be separated by filtration, and the liquid be slowly evaporated till it is considerably concentrated, a number of crystals are deposited when the liquid is left standing in a cool place. These crystals, first examined by Rouelle, consist of carbonate of soda, muriate of soda, besides phosphate of soda and phosphate of lime. The soda exists in the blood in a caustic state, and seems to be combined with the gelatine and albumen. The carbonic acid combines with it during evaporation.

2. The cruor, or *clot* as it is sometimes called, is of a red colour, and possesses considerable consistence. Its mean specific gravity is about 1.245. If this cruor be washed carefully, by letting a small jet of water fall upon it till the water runs off colourless, it is partly dissolved, and partly remains upon the searce. Thus it is separated into two portions: namely, 1. A white, solid, elastic substance, which has all the properties of *fibrin*; 2. The

portion held in solution by the water, which consists of the colouring matter, not however in a state of purity, for it is impossible to separate the cruor completely from the serum.

Bucquet proved that this watery solution contained albumen and iron. Menghini had ascertained, that if blood be evaporated to dryness by a gentle heat, a quantity of iron may be separated from it by the magnet. The quantity which he obtained was considerable: according to him, the blood of a healthy man contains above two ounces of it. Now, as neither the serum nor the fibrin extracted from the cruor contains iron, it follows of course, that the water holding the colouring matter in solution must contain the whole of that metal.

This watery solution gives a green colour to syrup of violets. When exposed to the air, it gradually deposites flakes, which have the properties of albumen. When heated, a brown-coloured scum gathers on its surface. If it be evaporated to dryness, and then mixed with alcohol, a portion is dissolved, and the alcoholic solution yields by evaporation a residuum which lathers like soap in water, and tinges vegetable blues green; the acids occasion a precipitate from its solution. This substance is a compound of albumen and soda. Thus we see that the watery solution contains albumen, iron, and soda.

Fourcroy and Vauquelin have ascertained, that the iron is combined with phosphoric acid, and in the state of subphosphate of iron; thus confirming an opinion which had been maintained by Sage, and announced as a fact by Gren.

Brande has lately shown, that the colouring matter of the blood is of an animal nature. He has proved, that it may be advantageously used as a dye-stuff.

Such are the properties of blood, as far as they have been hitherto ascertained by experiment. We have seen that it contains the following ingredients:

1. Water.
2. Fibrin.
3. Albumen.
4. Hydrosulph. of ammonia.
5. Soda.
6. Subphosphate of iron.
7. Muriate of soda.
8. Phosphate of soda.
9. Phosphate of lime.

Besides benzoic acid, which has been detected by Proust.

Sect. X. *Of Milk.*

Milk is a fluid secreted by the female of all those animals denominated *mammalia*, and intended evidently for the nourishment of her offspring.

The milk of every animal has certain peculiarities which distinguish it from every other milk. But the animal whose milk is most made use of by man as an article of food, and with which, consequently, we are best acquainted, is the *cow*. Chemists, therefore, have made choice of cow's milk for their experiments.

Milk is an opaque fluid, of a white colour, a slight peculiar smell, and a pleasant sweetish taste. When newly drawn from the cow, it has a taste very different from that which it acquires, after it has been kept for some hours. It reddens vegetable blues.

When milk is allowed to remain for some time at rest, there collects on its surface a thick unctuous yellowish-coloured substance, known by the name of cream.

After the cream is separated, the milk which remains is much thinner than before, and it has a bluish white colour. If it be heated to the temperature of 100°, and a little *rennet*, which is water digested with the inner coat of a calf's stomach, and preserved with salt, be poured into it, coagulation ensues; and if the coagulum be broken, the milk very soon separates into two substances; a solid white part known by the name of *curd*, and a fluid part called *whey*. Thus we see that milk may be easily separated into three parts; namely, *cream*, *curd*, and *whey*.

1. Cream is of a yellow colour, and its consistence increases gradually by exposure to the atmosphere. In three or four days it becomes so thick, that the vessel which contains it may be inverted without risking any loss. In eight or ten days more, its surface is covered over with mucors and byssi, and it has no longer the flavour of cream, but of very fat cheese.

Cream possesses many of the properties of an oil. It is specifically lighter than water; it has an unctuous feel, stains cloths precisely in the manner of oil; and if it be kept fluid, it contracts at last a taste which is very analogous to the rancidity of oils. These properties are sufficient to show us that it contains a quantity of oil; but this oil is combined with a part of the curd, and mixed with some serum. Cream, then, is composed of a peculiar oil, curd, and serum. The oil may be easily obtained separate, by agitating the cream for a considerable time. This process, known to every body, is called *churning*. After a certain time, the cream separates into two portions: one fluid, and resembling creamed milk; the other solid, and called *butter*.

Butter is of a yellow colour, possesses the properties of an oil, and mixes readily with other oily bodies. When heated to the temperature of 96° it melts, and becomes transparent; if it be kept for some time melted, some curd and water or whey separate from it, and it assumes exactly the appearance of oil. But this process deprives it in a great measure of its peculiar flavour.

Butter may be obtained, by agitating cream newly taken from milk, or even by agitating milk newly drawn from the cow. But it is usual to allow cream to remain for some time before it is churned. Now cream, by standing, acquires a sour taste; butter, therefore, is commonly made from sour cream. When very sour cream is churned, every one must have perceived, that the butter milk, after the churning, is not nearly so sour as the cream had been. The butter, in all cases, is perfectly sweet; consequently the acid which had been evolved. has in a great measure disappeared during the progress of churning. It has been ascertained that cream may be churned, and butter obtained, though the contact of atmospheric air be excluded. On the other hand, it has been affirmed, that when cream is churned in contact with air, it absorbs a considerable quantity of it.

In many cases, there is a considerable extrication of gas during the churning of water. From the phenomena, it can scarcely be doubted that this acid is carbonic acid. See Butter.

2. Curd, which may be separated from creamed milk by rennet, has many of the properties of coagulated albumen. It is white and solid; and when all the moisture is squeezed out, it has a good deal of brittleness. It is insoluble in water; but pure alkalies and lime dissolve it readily, especially when assisted by heat; and when fixed alkali is used, a great quantity of ammonia is emitted during the solution. The solution of curd in soda is of a red colour, at least if heat be employed, owing probably to the separation of charcoal from the curd by the action of the alkali. The matter dissolved by the alkali may be separated from it by means of an acid; but it has

lost all the properties of curd. It is of a black colour, melts like tallow by the application of heat, leaves oily stains on paper, and never acquires the consistence of curd. Its constituents, according to the experiments of Thenard and Gay Lussac, are as follows :

Carbon	59.781
Oxygen	11.409
Hydrogen	7.429
Azote	21.381
	100

Curd, as is well known, is used in making *cheese*, and the cheese is the better the more it contains of cream, or of that oily matter which constitutes cream. It is well known to cheesemakers, that the goodness of it depends in a great measure on the manner of separating the whey from the curd. If the milk be much heated, the coagulum broken in pieces, and the whey forcibly separated, as is the practice in many parts of Scotland, the cheese is scarce good for any thing ; but the whey is delicious, especially the last squeezed out whey, and butter may be obtained from it in considerable quantity :—a full proof that nearly the whole creamy part of the milk has been separated with the whey. Whereas if the milk be not too much heated, (about 100° is sufficient,) if the coagulum be allowed to remain unbroken, and the whey be separated by very slow and gentle pressure, the cheese is excellent ; but the whey is almost transparent, and nearly colourless.

Good cheese melts at a moderate heat ; but bad cheese, when heated, dries, curls, and exhibits all the phenomena of burning horn. From this it is evident, that good cheese contains a quantity of the peculiar oil which constitutes the distinguishing characteristic of cream ; hence its flavour and smell. Proust has found in cheese an acid, which he calls the *caseic* acid, to which he ascribes several of the peculiar properties of cheese. See DAIRY.

3. Whey, after being filtered, to separate a quantity of curd which still continues to float through it, is a thin pellucid fluid, of a yellowish green colour, and pleasant sweetish taste, in which the flavour of milk may be distinguished. It always contains some curd; but nearly the whole may be separated by keeping the whey for some time boiling ; a thick white scum gathers on the surface, which in Scotland is known by the name of *float whey*. When this scum, which consists of the curdy part, is carefully separated, the whey, after being allowed to remain at rest for some hours, to give the remainder of the curd time to precipitate, is decanted off almost as colourless as water, and scarcely any of the peculiar taste of milk can be distinguished in it. If it be now slowly evaporated, it deposites at last a number of white-coloured crystals, which are *sugar of milk*. Toward the end of the evaporation, some crystals of muriate of potash and of muriate of soda make their appearance. According to Scheele, it contains also a little phosphate of lime, which may be precipitated by ammonia.

The recent experiments of Fourcroy and Vauquelin, Thenard, and Bouillon La Grange, have added considerably to our knowledge of the constituents of whey. It always reddens vegetable blues, containing a portion of acetic acid. The lactic acid of Scheele is nothing else than this acid holding an animal matter in solution. It contains likewise some phosphate of magnesia and phosphate of iron, as Fourcroy and Vauquelin have discovered. Sulphate of potash, likewise, and a peculiar extractive matter, have been separated from it.

Thus we see that cow's milk is composed of the following ingredients :

1. Water.
2. Oil.
3. Curd.
4. Extractive.
5. Sugar of milk.
6. Acetic acid.
7. Muriate of soda.
8. Muriate of potash.
9. Sulphate of potash.
10. Phosphate of lime.
11. Phosphate of magnesia
12. Phosphate of iron.

The milk of all other animals, as far as it has hitherto been examined, consists nearly of the same ingredients; but there is a very great difference in their proportion.

SECT. XI. *Of Saliva.*

The fluid secreted in the mouth, which flows in considerable quantity during a repast, is known by the name of *saliva*.

Saliva is a limpid fluid like water, but much more viscid. It has neither smell nor taste. Its specific gravity, according to Hamberger, is 1.0167 ; according to Siebold, 1.080. When agitated, it froths like all other adhesive liquids ; indeed, it is usually mixed with air, and has the appearance of froth.

It neither mixes readily with water nor oil ; but by trituration in a mortar, it may be so mixed with water as to pass through a filter. It has a great affinity for oxygen, absorbs it readily from the air, and gives it out again to other bodies.

When boiled in water, a few flakes of albumen precipitate. From the experiments of Dr Bostock, we learn that this albumen is not in a state of solution. It is separated by the filter, and subsides of its own accord when the liquid is diluted with water. In his analysis, this coagulated albumen amounted to 0.4 of the solid matter contained in the saliva examined.

When saliva is evaporated, it swells exceedingly, and leaves behind it a thin brown coloured crust ; but if the evaporation be conducted slowly, small cubic crystals of muriate of soda are formed. The viscidity of saliva, the property which it has of absorbing oxygen, and of being inspissated, announce the presence of mucus as a component part. This is fully confirmed by the effect of neutral acetate of lead, which produces a copious precipitate in saliva. Dr Bostock considers the mucus as constituting about one-half of the solid contents of saliva.

When saliva is distilled in a retort, it froths very much ; 100 parts yield 80 parts of water nearly pure, then a little carbonate of ammonia, some oil, and an acid, which perhaps is the prussic. The residuum amounts to about 1.56 part, and is composed of muriate of soda, phosphate of soda, and phosphate of lime.

The acids and alcohol inspissate saliva ; the alkalies disengage ammonia ; oxalic acid precipitates lime ; and the nitrates of lead, mercury, and silver, precipitate phosphoric and muriatic acids.

From these facts it follows, that saliva, besides water, which constitutes at least four-fifths of its bulk, contains the following ingredients :

1. Mucilage.
2. Albumen.
3. Muriate of soda.
4. Phosphate of soda.
5. Phosphate of lime.
6. Phosphate of ammonia.

But it cannot be doubted, that, like all the other animal fluids, it is liable to many changes from disease, &c. Brugnatelli found the saliva of a patient labouring under an obstinate venereal disease impregnated with oxalic acid.

Sect. XII. *Of Bile.*

Bile is a liquid of a yellowish green colour, an unctuous feel, bitter taste, and peculiar smell, which is secreted by the liver; and, in most animals, considerable quantities of it are usually found collected in the gall bladder.

1. Ox bile is a liquid of a yellowish green, and sometimes of a deep green colour. Its taste is very bitter, but at the same time sweetish. Its smell is feeble, but peculiar and disagreeable. It does not act on vegetable blues. Its consistence varies very much. Sometimes it is a thin mucilage; sometimes very viscid and glutinous; sometimes it is perfectly transparent; and sometimes it contains a yellow-coloured matter, which precipitates when the bile is diluted with water.

When an acid is added to bile, even in a minute quantity, it acquires the property of reddening vegetable blues. The addition of a little more acid occasions a precipitate, and sulphuric acid occasions a greater precipitate than any other acid. This precipitate consists of a yellow-coloured matter, often visible in bile, and which is insoluble in water. It contains also a little resin, which gives it a bitter taste. Acids do not throw down the whole resin from bile. Yet if the resin be dissolved in soda, it is readily precipitated by all the acids; a proof that the resin is not kept in solution in bile by soda.

When superacetate of lead is poured into bile, a copious white precipitate falls, consisting of the resin combined with the oxide of lead. The superacetate of commerce does not readily throw down the whole resin; but if eight parts of common sugar of lead and one part of litharge be united together by digestion in water, a salt is formed, which readily throws down the whole of the resin. If the precipitate be treated with diluted nitric acid, the lead is separated, and the resin remains behind in a state of purity. It is a green-coloured bitter tasted substance, possessing most of the properties of resins. It has been already described in the preceding Section. One hundred parts of bile contain about three parts of resin.

If acetate of lead be poured into bile thus deprived of its resin by the superacetate, a new and more copious precipitate falls, consisting of the oxide of lead united to a peculiar substance, which gives bile most of its characters. This substance was first described in detail by Thenard, who has given it the name of *picromel.* The compound, consisting of oxide of lead and picromel, is soluble in acetic acid. If a current of sulphureted hydrogen gas be passed through the solution, the lead is separated; and by filtering and evaporating the liquid to dryness, the picromel is obtained in a separate state. When bile, mixed with muriatic acid and filtered, is set aside for some months in an open vessel, I have seen the picromel separate of its own accord. It is a white solid substance in small globules. It has a sweet, and at the same time an acrid taste, and is often somewhat bitter from retaining a portion of the resin. It facilitates the solution of resin in water: three parts of picromel and one part of resin dissolve in water.

By evaporating a quantity of bile to dryness, calcining it, and proceeding in the usual way, Thenard ascertained the proportion of salts which it contained. The following was the result of his analysis of 800 parts of bile:

700.0	water.
24.0	resin.
60.3	picromel.
4.5	yellow matter.
4.0	soda.
2.0	phosphate of soda.
3.2	muriate of soda.
0.8	sulphate of soda.
1.2	phosphate of lime.
	oxide of iron, a trace.
800.0	

2. Such are the properties and the constituents of ox bile, as far as they have been examined by Thenard. From the experiments of the same chemist, it appears that the bile of the calf, the dog, the sheep, and the cat, resemble that of the ox exactly, both in their properties and their constituents.

3. The bile of the sow differs entirely from that of all these animals. It contains neither albumen, nor animal matter, nor picromel, but is merely a soap, as it contains a great quantity of resin and of soda, and is decomposed with facility by all the acids, even by vinegar. It contains traces also of several salts; but Thenard did not ascertain their nature.

4. The bile of the common hen, of the turkey, and the duck, has a good deal of resemblance to that of quadrupeds. But it differs in the following particulars: 1. It contains a considerable quantity of albumen; 2. The picromel has no sensible sweet taste, but is very acrid and bitter; 3. It contains very little soda; 4. The resin is not precipitated by common superacetate of lead; but superacetate, boiled with one-fourth of its weight of litharge, occasions it to precipitate.

5. The bile of the thornback and salmon is yellowish white. When evaporated, it leaves a matter which has a very sweet and slightly acrid taste. It appears to contain no resin. The bile of the carp and the eel is very green, very bitter, contains little or no albumen, but yields soda, resin, and a sweet acrid matter, similar to that which may be obtained from salmon bile.

6. Human bile differs considerably from that of all other animals examined. Its taste is not very bitter. It is seldom completely liquid, but usually contains some yellow matter suspended in it. When evaporated to dryness, it leaves a brown matter, amounting to about $\frac{1}{11}$th of the original weight. All the acids decompose human bile, and throw down a copious precipitate, consisting of albumen and resin. The following were the proportions of the constituents obtained by Thenard from 1100 parts of human bile.

1000.0	water.
from 2 to 10	yellow insoluble matter.
	yellow matter in solution, a trace.
42.0	albumen.
41.0	resin.
5.6	soda.
4.5	phosphate of soda, sulphate of soda, muriate of soda, phosphate of lime, oxide of iron.

Sect. XIII. *Of the Cerumen of the Ear.*

Cerumen is a viscid yellow-coloured liquid secreted by the glands of the auditory canal, which gradually becomes concrete by exposure to the air.

It has an orange yellow colour, and a bitter taste. When slightly heated upon paper, it melts and stains the paper like an oil; at the same time it emits a slightly aromatic odour. On burning coals it softens, and emits a white smoke, which resembles that given out by burning fat; it afterwards melts, swells, becomes dark coloured, and emits an ammoniacal and empyreumatic odour. A light coal remains behind.

When agitated in water, cerumen forms a kind of emulsion, which soon putrefies, depositing at the same time white flakes.

Alcohol, when assisted by heat, dissolves five-eighths of the cerumen; the three-eighths which remain behind have the properties of albumen, mixed however with a little oily matter. When the alcohol is evaporated, it leaves a deep orange residuum of a very bitter taste, having a smell and a consistence analogous to turpentine. It melts when heated, evaporates in a white smoke without leaving any residuum, and, in short, resembles very strongly the *resin of bile*. Ether also dissolves this oily body; but it is much less bitter, and much lighter coloured. When the albuminous part of cerumen is burnt, it leaves traces of soda and of phosphate of lime. From these facts, Vauquelin considers cerumen as composed of the following substances:

1. Albumen.
2. An inspissated oil.
3. A colouring matter.
4. Soda.
5. Phosphate of lime.

SECT. XIV. *Of Tears and Mucus.*

1. The liquid called tears is transparent and colourless like water; it has scarcely any smell, but its taste is always perceptibly salt. Its specific gravity is somewhat greater than that of distilled water. It gives to paper stained with the juice of the petals of mallows or violet a permanently green colour, and therefore contains a fixed alkali. It unites with water, whether cold or hot, in all proportions. Alkalies unite with it readily, and render it more fluid. The mineral acids produce no apparent change upon it. Exposed to the air, this liquid gradually evaporates, and becomes thicker. When nearly reduced to a state of dryness, a number of cubic crystals form in the midst of a kind of mucilage. These crystals possess the properties of muriate of soda; but they tinge vegetable blues green, and therefore contain an excess of soda. The mucilaginous matter acquires a yellowish colour as it dries.

When alcohol is poured into this liquid, a mucilaginous matter is precipitated in the form of large white flakes. The alcohol leaves behind it, when evaporated, traces of muriate of soda and soda. The residuum which remains behind, when inspissated tears are burnt in the open air, exhibits some traces of phosphate of lime, and phosphate of soda.

Thus it appears, that tears are composed of the following ingredients:

1. Water.
2. Mucus.
3. Muriate of soda.
4. Soda.
5. Phosphate of lime.
6. Phosphate of soda.

The saline parts amount only to about 0.01 of the whole, or probably not so much.

2. The mucus of the nose has also been examined by Fourcroy and Vauquelin. They found it composed of precisely the same ingredients with the tears. As this fluid is more exposed to the action of the air than the tears, in most cases its mucilage has undergone less or more of that change which is the consequence of the absorption of oxygen. Hence the reason of the greater viscidity and consistence of the mucus of the nose; hence also the great consistence which it acquires during colds, where the action of the atmosphere is assisted by the increased action of the parts.

3. As to the mucus which lubricates the alimentary canal, the trachea, the bronchiæ, the urethra, and all the different cavities of the body, nobody has hitherto subjected it to analysis, because it cannot be obtained in sufficient quantity. It is viscid, and no doubt contains a mucilaginous substance, similar to that contained in the saliva, the tears, and the mucus of the nose; as, like these liquids, is is liable to become much more thick by exposure to the air.

SECT. XV. *Liquor of the Pericardium.*

This is a liquor which lubricates the heart. It has been lately examined by Dr Bostock, having been obtained from the pericardium of a boy who had died suddenly.

It had the colour and appearance of the serum of the blood. Evaporated to dryness, it left a residue amounting to $\frac{1}{13}$th of its weight. When exposed to the heat of boiling water, it became opake and thready. It was copiously precipitated by oxymuriate of mercury before boiling; but when boiled, evaporated to dryness, and redissolved, the solution was not affected by oxymuriate of mercury. These experiments show us that it contained albumen. When saturated with oxymuriate of mercury, infusion of galls produced no effect, indicating the absence of gelatine. It was copiously precipitated by neutral acetate of lead, even after being boiled to dryness, and the residue re-dissolved in water. Nitrate of silver indicated the presence of muriatic acid. Dr Bostock, from his experiments, considers it composed of

Water	92.0
Albumen	5.5
Mucus	2.0
Muriate of soda	0.5
	100.0

SECT. XVI. *Of the Humours of the Eye.*

The eye is one of the most delicate and complicated organs in the body; at the same time its structure, and the uses of its parts, are better understood than almost any of the other instruments of sensation. It is composed of several concentric coats, which have not been chemically examined; but, from the experiments of Hatchett on similar substances, we may consider it as probable that they possess the properties of coagulated albumen. The internal part of the eye is chiefly filled with three transparent substances, which have been called *humours* by anatomists; namely, 1. The *aqueous humour*, immediately behind the cornea; 2. The *crystalline humour*, or *lens*; and, 3. The *vitreous humour*, behind the lens, and occupying the greatest part of the eye.

1. The aqueous humour of the eye of the sheep is a clear transparent liquid like water, which has very little smell or taste when fresh. Its specific gravity is 1.0090 at the temperature of 60°. It appears to be water slightly impregnated with the following substances:

1. Albumen. 2. Gelatine. 3. Muriate of soda.

2. The vitreous matter possesses the very same properties as the aqueous; even its specific gravity is the same, or only a very little greater.

3. The crystalline lens is solid; densest in the centre,

and becoming less solid towards the circumference. It is composed of concentric coats, and is transparent. Its specific gravity is 1.1000. When fresh, it has little taste. It putrefies very rapidly.

It is almost completely soluble in water. The solution is partly coagulated by heat, and gives a copious precipitate with tannin, both before the coagulation and after it. It gives no traces of muriatic acid. Hence it is composed of albumen and gelatine united to water. According to Nicholas, the quantity of gelatine diminishes as we approach the centre of the lens, where it is very small. He detected phosphate of lime likewise in every part of the lens.

The humours of the human eye are composed of the same ingredients as those of the sheep; the only perceptible difference consists in their specific gravity. The specific gravity of the human aqueous and vitreous humours is 1.0053; that of the crystalline 1.0790.

The humours of the eyes of oxen resemble those of the sheep in their composition. The specific gravity of the aqueous and vitreous humours is 1.0088; that of the crystalline 1.0765.

Sect. XVII. *Of Sinovia.*

Within the capsular ligament of the different joints of the body there is contained a peculiar liquid, intended evidently to lubricate the parts, and to facilitate their motion. This liquid is known among anatomists by the name of *sinovia*.

The sinovia of the ox, when it has just flowed from the joint, is a viscid semitransparent fluid, of a greenish white colour, and a smell not unlike frog-spawn. It very soon acquires the consistence of jelly; and this happens equally whether it be kept in a cold or a hot temperature, whether it be exposed to the air or excluded from it. This consistence does not continue long; the sinovia soon recovers again its fluidity, and at the same time deposites a thready-like matter.

Sinovia mixes readily with water, and imparts to that liquid a great deal of viscidity. The mixture froths when agitated; becomes milky when boiled, and deposites some pellicles on the sides of the dish; but its viscidity is not diminished.

When alcohol is poured into sinovia, a white substance precipitates, which has all the properties of albumen. One hundred parts of sinovia contain 4.52 of albumen. The liquid still continues as viscid as ever: but if acetic acid be poured into it, the viscidity disappears altogether, the liquid becomes transparent, and deposites a quantity of matter in white threads, which possesses the following properties: 1. It has the colour, smell, taste, and elasticity of vegetable gluten. 2. It is soluble in concentrated acids and pure alkalies. 3. It is soluble in cold water; the solution froths. Acids and alcohol precipitate the fibrous matter in flakes. On hundred parts of sinovia contain 11.86 of this matter.

Margueron found that 100 parts of sinovia contained about 0.71 of soda.

When sinovia is exposed to a dry atmosphere, it gradually evaporates, and a scaly residuum remains, in which cubic crystals, and a white saline efflorescence, are apparent. The cubic crystals are muriate of soda. One hundred parts of sinovia contain 1.75 of this salt. The saline efflorescence is carbonate of soda.

From the analysis of Mr Margueron, it appears that sinovia is composed of the following ingredients:

11.86	fibrous matter,
4.52	albumen,
1.75	muriate of soda,
.71	soda,
.70	phosphate of lime,
80.46	water.
100.00	

Sect. XVIII. *Of Semen.*

The peculiar liquid secreted in the testes of males, and destined for the impregnation of females, is known by the name of *semen*.

Semen, when newly ejected, is evidently a mixture of two different substances: the one fluid and milky, which is supposed to be secreted by the prostate gland; the other, which is considered as the true secretion of the testes, is a thick mucilaginous substance, in which numerous white shining filaments may be discovered. It has a slight disagreeable odour, an acrid irritating taste, and its specific gravity is greater than that of water. When rubbed in a mortar, it becomes frothy, and of the consistence of pomatum, in consequence of its enveloping a great number of air bubbles. It converts paper stained with the blossoms of mallows or violets to a green colour, and consequently contains an alkali.

As the liquid cools, the mucilaginous part becomes transparent, and acquires greater consistency; but in about twenty minutes after its emission, the whole becomes perfectly liquid. This liquefaction is not owing to the absorption of moisture from the air, for it loses instead of acquiring weight during its exposure to the atmosphere; nor is it owing to the action of the air, for it takes place equally in close vessels.

When oxymuriatic acid is poured into semen, a number of white flakes precipitates, and the acid loses its peculiar odour. These flakes are insoluble in water, and even in acids. If the quantity of acid be sufficient, the semen acquires a yellow colour. Thus it appears that semen contains a mucilaginous substance, analogous to that of the tears, which coagulates by absorbing oxygen. Mr Vauquelin obtained from 100 parts of semen six parts of this mucilage.

When semen is exposed to the air about the temperature of 60°, it becomes gradually covered with a transparent pellicle, and in three or four days deposites small transparent crystals, often crossing each other in such a manner as to represent the spokes of a wheel. These crystals, when viewed through a microscope, appear to be four-sided prisms, terminated by very long four-sided pyramids. They may be separated by diluting the liquid with water, and decanting it off. They have all the properties of phosphate of lime. If, after the appearance of these crystals, the semen be still allowed to remain exposed to the atmosphere, the pellicle on its surface gradually thickens, and a number of white round bodies appear on different parts of it. These bodies also are phosphate of lime, prevented from crystallizing regularly by the too rapid abstraction of moisture. Mr Vauquelin found that 100 parts of semen contain three parts of phosphate of lime. If, at this period of the evaporation, the air becomes moist, other crystals appear in the semen, which have the properties of carbonate of soda. The evaporation does not go on to complete exsiccation, unless at the temperature of 77°, and when the air is very dry. When all the moisture is evaporated, the semen has lost 0.9 of its weight; the residuum is semi-transparent like horn, and brittle.

Thus it appears that semen is composed of the following ingredients:

90	water.
6	mucilage.
3	phosphate of lime.
1.	soda.
100	

Sect. XIX. *Of Animal Poisons.*

Several animals are furnished with liquid juices of a poisonous nature, which, when poured into fresh wounds, occasion the disease or death of the wounded animal. Serpents, bees, scorpions, spiders, are well known examples of such animals. The chemical properties of these poisonous juices deserve peculiar attention; because it is only from such an investigation that we can hope to explain the fatal changes which they induce on the animal economy, or to discover an antidote sufficiently powerful to counteract their baneful influence. Unfortunately the task is difficult, and perhaps surpasses our chemical powers. For the progress already made in the investigation, we are indebted almost entirely to the labours of Fontana.

1. The poison of the viper is a yellow liquid, which lodges in two small vesicles in the animal's mouth. These communicate by a tube with the crooked fangs, which are hollow, and terminate in a small cavity. When the animal bites, the vesicles are squeezed, and the poison is forced through the fangs into the wound.

This poisonous juice occasions the fatal effects of the viper's bite. It has a yellow colour, has no taste; but when applied to the tongue occasions numbness. It has the appearance of oil before the microscope, but it unites readily with water. It produces no change on vegetable blues.

When exposed to the open air, the watery part gradually evaporates, and a yellowish-brown substance remains, which has the appearance of gum arabic. In this state it feels viscid like gum between the teeth; it dissolves readily in water, but not in alcohol; and alcohol throws it down in a white powder from water. Neither acids nor alkalies have much effect upon it. It does not unite with volatile oils nor sulphuret of potash. When heated it does not melt, but swells, and does not inflame till it has become black. These properties are similar to the properties of gum, and indicate the gummy nature of this poisonous substance. Fontana made a set of experiments on the dry poison of the viper, and a similar set on gum arabic, and obtained the same results.

From the late observations of Dr Russel, there is reason to believe that the poisonous juices of the other serpents are similar in their properties to those of the viper.

This striking resemblance between gums and the poison of the viper, two substances of so opposite a nature in their effects upon the living body, is a humiliating proof of the small progress we have made in the chemical knowledge of these intricate substances. The poison of the viper, and of serpents in general, is most hurtful when mixed with the blood. Taken into the stomach it kills, if the quantity be considerable. Fontana has ascertained that its fatal effects are proportional to its quantity, compared with the quantity of the blood. Hence the danger diminishes as the size of the animal increases. Small birds and quadrupeds die immediately when they are bitten by a viper; but to a full-sized man the bite seldom proves fatal.

Ammonia has been proposed as an antidote to the bite of the viper. It was introduced in consequence of the theory of Dr Mead, that the poison was of an acid nature. The numerous trials of that medicine by Fontana robbed it of all its celebrity; but it has been lately revived and recommended by Dr Ramsay as a certain cure for the bite of the rattlesnake.[*]

2. The venom of the bee and the wasp is also a liquid, contained in a small vesicle, forced through the hollow tube of the sting into the wound inflicted by that instrument. From the experiments of Fontana, we learn that it bears a striking resemblance to the poison of the viper. That of the bee is much longer in drying when exposed to the air than the venom of the wasp.

3. The poison of the scorpion resembles that of the viper also. But its taste is hot and acrid, which is the case also with the venom of the bee and the wasp.

4. No experiments upon which we can rely have been made upon the poison of the spider tribe. From the rapidity with which these animals destroy their prey, and even one another, we cannot doubt that their poison is sufficiently virulent.

Sect. XX. *Of Sweat.*

A quantity of matter is constantly emitted from the skin; this matter is invisible, and is distinguished by the name of *perspiration*. Several experiments were made by Lavoisier and Seguin to ascertain its amount. Mr Cruickshanks made numerous trials to determine its nature, and it has been lately subjected to a chemical examination by Thenard.

1. Mr Cruickshanks put his hand into a glass vessel, and luted its mouth at his wrist by means of a bladder. The interior surface of the vessel became gradually dim, and drops of water trickled down. By keeping his hand in this manner for an hour, he collected 30 grains of a liquid, which possessed all the properties of pure water. On repeating the same experiment at nine in the evening (thermometer 62°,) he collected only 12 grains. The mean of these is 21 grains. But as the hand is more exposed than the trunk of the body, it is reasonable to suppose that the perspiration from it is greater than that from the hand. Let us therefore take 30 grains per hour as the mean; and let us suppose, with Mr Cruickshanks, that the hand is $\frac{1}{60}$th of the surface of the body: The perspiration in an hour would amount to 1880 grains, and in 24 hours to 43,200 grains, or seven pounds six ounces troy. This is almost double of the quantity ascertained by Lavoisier and Seguin. Hence we may conclude that more matter is perspired through the hand than the other parts of the body, provided Mr Cruickshank's estimate of the ratio between the surface of the hand and body be not erroneous.

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[*] Dr Barton, who has probably made as great a number of experiments on the poison of the rattlesnake as any person, has not found ammonia to be efficacious in preventing its fatal operation. A considerable proportion of the animal's bitter will struggle through the effects of the bite, even when no remedy is applied; and it is most probably in such cases that the ammonia has been supposed to prove efficacious. Coxe.

He repeated the experiment again after hard exercise, and collected in an hour 48 grains of water. He found also, that this aqueous vapour pervaded his stocking without difficulty; and that it made its way through a shamoy leather glove, and even through a leather boot, though in a much smaller quantity than when the leg wanted that covering.

2. Besides water, it cannot be doubted that *carbon* is also emitted from the skin; but in what state, the experiments hitherto made do not enable us to decide. Mr Cruickshanks found that the air of the glass vessel in which his hand and foot had been confined for an hour contained carbonic acid gas; for a candle burned dimly in it, and it rendered limewater turbid.

3. Besides water and carbon, or carbonic acid gas, the skin emits also a particular odorous substance. That every animal has a peculiar smell, is well known: the dog can discover his master, and even trace him to a distance, by the scent. A dog, chained some hours after his master had set out on a journey of some hundred miles, followed his footsteps by the smell, and found him on the third day in the midst of a crowd. But it is needless to multiply instances of this fact; they are too well known to every one. Now this smell must be owing to some peculiar matter which is constantly emitted; and this matter must differ somewhat either in quantity or some other property, as we see that the dog easily distinguishes the individual by means of it. Mr Cruickshanks has made it probable that this matter is an oily substance; or at least that there is an oily substance emitted by the skin. He wore repeatedly, night and day, for a month, the same vest of fleecy hosiery during the hottest part of the summer. At the end of this time he always found an oily substance accumulated in considerable masses on the nap of the inner surface of the vest, in the form of black tears. When rubbed on paper, it makes it transparent, and hardens on it like grease. It burns with a white flame, and leaves behind it a charry residuum.

4. Berthollet has observed the perspiration acid; and he has concluded that the acid which is present is the phosphoric: but that has not been proved. Indeed the late experiments of Thenard have proved that the acid in *perspired matter* is not the phosphoric, but the acetic. He employed the method practised by Mr Cruickshanks to collect this matter. Different persons wore clean flannel waistcoats next their skin for ten days; the waistcoats had been first washed with soap, then in pure water, then in water acidulated with muriatic acid, and lastly in a great quantity of pure water. He steeped the waistcoats in hot distilled water, and thus separated from them the perspired matter. The liquid was put into a retort, and concentrated to the consistence of a syrup. The liquid which came over had a disagreeable smell, and reddened infusion of litmus. Kept in an open vessel it retained its transparency, but lost its odour. The residue in the retort had no smell. It was strongly acid, and tasted distinctly of common salt, while at the same time an acrid and hot flavour could be distinguished. When evaporated to dryness and strongly heated, the acid which it contained was dissipated or destroyed, and the residue consisted of common salt, charcoal, and minute traces of phosphate of lime, and oxide of iron. The same destruction of the acid took place if it was previously saturated with potash before it was heated to redness, and in that case the potash was converted into a carbonate. When saturated with an alkali, and distilled along with phosphoric acid, it yielded an acid which possessed all the characters of the acetic.

5. The small quantity of animal matter which Thenard found in the perspired matter, possessed characters which induced him to consider it as similar to gelatine in its nature.

SECT. XXI. *Of Urine.*

Fresh urine differs considerably in its appearance, according to the state of the person, and the time at which it is voided. In general, healthy urine is a transparent liquid of a light amber colour, an aromatic odour resembling that of violets, and a disagreeable bitter taste. Its specific gravity varies, according to Mr Cruickshanks, from 1.005 to 1.033. When it cools, the aromatic smell leaves it, and is succeeded by another, well known by the name of *urinous smell.*

1. Urine reddens paper stained with turnsole and with the juice of radishes, and therefore contains an acid. This acid has been generally considered as the phosphoric; but Thenard has shown that it is in reality the acetic.

2. If a solution of ammonia be poured into fresh urine, a white powder precipitates, which has the properties of phosphate of lime.

3. If the phosphate of lime precipitated from urine be examined, a little magnesia will be found mixed with it. Fourcroy and Vauquelin have ascertained, that this is owing to a little phosphate of magnesia which urine contains, and which is decomposed by the alkali of lime employed to precipitate the phosphate of lime.

4. Proust informs us, that carbonic acid exists in urine, and that its separation occasions the froth which appears during the evaporation of urine.

5. Proust has observed, that urine kept in new casks deposites small crystals, which effloresce in the air and fall to powder. These crystals possess the properties of the carbonate of lime.

6. When fresh urine cools, it often lets fall a brick-coloured precipitate, which Scheele first ascertained to be crystals of uric acid. All urine contains this acid, even when no sensible precipitate appears when it cools.

7. During intermitting fevers, and especially during diseases of the liver, a copious sediment of a brick-red colour is deposited from urine. This sediment contains the rosacic acid of Proust.

8. If fresh urine be evaporated to the consistence of a syrup, and muriatic acid be then poured into it, a precipitate appears, which possesses the properties of benzoic acid.

9. When an infusion of tannin is dropt into urine, a white precipitate appears, having the properties of the combination of tannin and albumen or gelatine. Their quantity in healthy urine is very small, often indeed not sensible. Cruickshanks found that the precipitate afforded by tannin in healthy urine amounted to $\frac{1}{240}$th part of the weight of the urine.

10. If urine be evaporated by a slow fire to the consistence of a thick syrup, it assumes a deep brown colour, and exhales a fetid ammoniacal odour. When allowed to cool, it concretes into a mass of crystals, composed of all the component parts of urine. If four times its weight of alcohol be poured into this mass, at intervals, and a slight heat be applied, the greatest part of it

is dissolved. The alcohol which has acquired a brown colour, is to be decanted off, and distilled in a retort in a sand heat, till the mixture has boiled for some time, and acquired the consistence of a syrup. By this time the whole of the alcohol has passed off, and the matter, on cooling, crystallizes in quadrangular plates, which intersect each other. This substance is *urea*, which composes $\frac{9}{20}$ths of the urine, provided the watery part be excluded. To this substance the taste and smell of urine are owing. It is a substance which characterises urine, and constitutes it what it is, and to which the greater part of the very singular phenomena of urine are to be ascribed.

11. According to Fourcroy and Vauquelin, the colour of urine depends upon the urea: the greater the proportion of urea, the deeper the colour. But Proust has detected a resinous matter in urine similar to the resin of bile; and to this substance he ascribes the colour of urine.

12. If urine be slowly evaporated to the consistence of a syrup, a number of crystals make their appearance on its surface; these possess the properties of the muriate of soda.

13. The saline residuum which remains, after the separation of urea from crystallized urine by means of alcohol, has been long known by the names of *fusible salt of urine* and *microcosmic salt*.

When these salts are examined, they are found to have the properties of phosphates. The rhomboidal prisms consist of phosphate of ammonia united to a little phosphate of soda; the rectangular tables, on the contrary, are phosphate of soda, united to a small quantity of phosphate of ammonia. Urine, then, contains phosphate of soda and phosphate of ammonia.

14. When urine is cautiously evaporated, a few cubic crystals are often deposited among the other salts; these crystals have the properties of muriate of ammonia.

15. When urine is boiled in a silver bason, it blackens the bason; and if the quantity of urine be large, small crusts of sulphuret of silver may be detached. Hence we see that urine contains sulphur.

Urine, then, contains the following substances:

1. Water.
2. Acetic acid.
3. Phosphate of lime.
4. Phosphate of magnesia.
5. Carbonic acid.
6. Carbonate of lime.
7. Uric acid.
8. Rosacic acid.
9. Benzoic acid.
10. Albumen.
11. Urea.
12. Resin.
13. Muriate of soda.
14. Phosphate of soda.
15. Phosphate of ammonia.
16. Muriate of ammonia.
17. Sulphur.

These are the only substances which are constantly found in healthy urine; but it contains also occasionally other substances. Very often muriate of potash may be distinguished among the crystals which form during its evaporation. The presence of this salt may always be detected by dropping cautiously some tartaric acid into urine. If it contains muriate of potash, there will precipitate a little tartar, which may be easily recognized by its properties.

Urine sometimes also contains sulphate of soda, and even sulphate of lime. The presence of these salts may be ascertained by pouring into urine a solution of muriate of barytes; a copious white precipitate appears, consisting of the barytes combined with phosphoric acid, and with sulphuric acid, if any be present. This precipitate must be treated with a sufficient quantity of muriatic acid. The phosphate of barytes is dissolved, but the sulphate of barytes remains unaltered.

Sect. XXII. *Of Morbid Concretions.*

Hard substances occasionally make their appearance in different parts of the animal body, both in the solids and the cavities destined to contain the fluids. In the first case they are denominated *concretions* or *ossifications*; in the second *calculi*. Their formation is an irregularity in the animal œconomy, and they often produce the most excruciating diseases. They may be divided into five classes; namely, 1. Ossifications; 2. Intestinal concretions; 3. Biliary calculi; 4. Urinary calculi; 5. Gouty calculi.

1. *Ossifications.*

Under this name may be comprehended all the concretions which make their appearance in the solid parts of the animal body. The following are the most remarkable of these:

1. Small concretions sometimes form in the pineal gland. They consist of phosphate of lime.

2. Small concretions sometimes form in the salivary glands. These likewise consist of phosphate of lime.

3. Pulmonary concretions are occasionally coughed up by consumptive patients. They consist sometimes of phosphate of lime, sometimes of carbonate of lime, and sometimes of a mixture of both.

4. Hepatic concretions are composed of phosphate of lime, and a tough animal membrane.

5. The concretions which sometimes form in the prostate-gland are composed of phosphate of lime.

2. *Intestinal Concretions.*

Concretions sometimes form in the stomach and intestines, chiefly of the inferior animals. Some of these have been celebrated under the name of *bezoars* for their medical virtue. A great many of them have been analyzed, and no fewer than eight species have been ascertained.

The first species consist of concretions composed of superphosphate of lime, the second of phosphate of magnesia, the third of ammonio-phosphate of magnesia; the fourth of the yellow matter of bile; the fifth of a green-coloured resinous matter; the sixth of small fragments of the *boletus igniarius*; the seventh of balls of hair felted together; and the eighth of woody fibre.

3. *Biliary Calculi.*

Hard bodies sometimes form in the gall bladder and gall ducts, and occasion painful diseases. Four kinds of these calculi have been distinguished; the first kind is composed of a matter resembling spermaceti in appearance, soluble in hot alcohol, and crystallizing as the alcohol cools. This matter has been called *adipocire*. The second kind are angular, because a number of them exist in the gall bladder together. They are composed of adipocire, with a thin external crust of yellow matter of bile. The third kind are of a brown colour, and are supposed to be composed of the altered yellow matter of bile. The gall stones of oxen usually are of this kind. The fourth kind does not flame, but gradually waste away at a red heat.

4. *Urinary Calculi.*

It is well known that concretions not unfrequently form in the urinary bladder, and occasion one of the most dismal diseases to which the human species is liable. These bodies have been carefully and repeatedly examined by modern chemists, who have found them to be very various in their composition. No less than nine distinct substances have been found. These being mixed in different proportions, occasion great variation in the composition of the calculi. The following are the substances:

1. Uric acid.
2. Phosphate of lime.
3. Phosphate of magnesia-and-ammonia.
4. Oxalate of lime.
5. Muriate of ammonia.
6. Magnesia.
7. Phosphate of iron.
8. Silica.
9. Urea.

The four first of these constitute by far the most common and abundant ingredients of urinary calculi.

5. *Gouty Concretions.*

It is well known that concretions occasionally make their appearance in joints long subject to the gout. These concretions, from their colour and softness, are usually distinguished by the name of chalk-stones. They are usually small, though they have been observed of the size of an egg. All of them hitherto examined have been found composed of uric acid and soda, so that they consist of the salt called urate of soda.

PART III.

ON CHEMICAL APPARATUS.

Having in the preceding part of the article given a pretty full outline of the present state of chemical science, it still remains for us to make our readers acquainted with the nature of the apparatus employed by chemists, and with the manner of conducting chemical experiments. We must warn our readers, however, not to be led away by the too common notion, that an expensive chemical apparatus is indispensible for making any progress in chemical investigations.* By far the most eminent chemist who has ever appeared, we mean Scheele, conducted his researches, and completed his discoveries, with a very slender apparatus indeed. The same remark applies to Dr Priestley. And Mr Dalton, one of the most ingenious of the chemical philosophers at present in Britain, has conducted all his acute researches, and made all his important discoveries, with an apparatus so slender as to astonish every person who has seen it, and is acquainted with the numerous and important discoveries made by this celebrated philosopher.

That we may give some interest to this part of our subject, which is naturally dry and disagreeable, though of essential importance, we shall suppose ourselves giving directions to a young student, who wishes to make a complete set of experiments on every branch of chemical science. Now there are four distinct departments in chemistry, which require each a peculiar apparatus, and which must therefore be described separately. These are *heat*, *gaseous bodies*, *liquids*, and *solids*.

Chap. I.

Apparatus for Experimenting on Heat.

1. The first and most essential instrument for experimenting on heat, is the *thermometer*, an instrument which, by the expansion of a liquid confined in a glass tube, indicates the temperature of any substance to which it is applied. For an account of the construction of different kinds of thermometers, we refer to the article Thermometer. Fahrenheit's thermometer is the one commonly used in this country.† The freezing point on it is marked 32°, the point of boiling water is marked 212°, so that in this thermometer the interval between freezing and boiling water is divided into 180 degrees. The practical chemist ought to be provided with a variety of thermometers; some graduated as high as the boiling point of mercury, others as low as the freezing point of that metal. He should be even provided with a spirit of wine thermometer, graduated as low as 100°. If he is engaged in making experiments on the capacity of bodies for heat, he ought to have thermometers so delicate as to point out very minute changes of temperature. Dr Crawford had a thermometer in which every one of the usual degrees was divided into 50 parts, so that he could measure, with tolerable precision, the hundredth part of a degree of Fahrenheit's thermometer. It was with this very delicate instrument that he determined the specific heat of the gaseous bodies.

The differential thermometer, invented by Mr Leslie, is an instrument of considerable value in ascertaining minute changes in temperature confined to a particular spot, when our object is not to determine the variation of the temperature of the room in which we are, but the peculiar variation in any point, independent of the general variation. It consists of two equal glass balls, joined together by a glass tube bent somewhat in the form of a U. The tube is filled with a coloured liquid. If one of the glass balls be placed in a position hotter than that in which the other ball is placed, the air within it expands and presses down the liquid in the end of the tube nearest it. A scale of degrees is attached to this leg of the tube, by which the heat that the ball experiences is indicated. See the thermometer represented in Plate CXLI. Fig. 1.

Various thermometers, or *pyrometers* as they have been called, have been contrived to measure high degrees of heat, as the fusing points of the metals, to most of which a common thermometer cannot be applied. One of the first of these was contrived by Dr Cromwell Mortimer. It consisted of a rod of steel or brass, which, by its expansion, moved a lever turning upon an axis, and pointing out the various degrees upon a plate. Though this instrument is not susceptible of much accuracy, yet as Dr Mortimer employed it to determine the fusing point of tin, lead, zinc, and antimony, and as the degrees which he pointed out are still to be found in modern chemical books, though seldom any reference is made to the original experimenter, we shall give a description and figure of his pyrometer in this place. In Figure 2. AB is a round rod of steel or brass, a quarter of an inch thick and three feet one inch long. When the rod is of brass three feet long, the point A must be of steel one inch long, to prevent its wearing away or losing its point, which conical point is made to screw on and off. CD, *cd*, are two iron supporters, joined by a flat cross bar at bottom D *d*, two inches long, in the middle of which is a point $\frac{1}{8}$th of an inch high under B, which goes into a hole at the bottom of the rod B, and serves to keep the rod in its place at bottom; as the cross bar * *, having a hole in it through which the rod passes, does in the middle, or about two thirds up the supporters, and the point A goes into a small hole in the under side of the lever, all which keep the upright rod firm and steady in its place. The iron supporters are flat, or parallel to the front of the machine from C to X, and *c* to *x*, where they are twisted half round, so that the lower parts XD, *xd*, stand at right angles with the upper parts. This contrivance gives the freer access to the rod for the sand or fluid into which the machine is set to measure its heat, the supporters standing two inches asunder at D *d*; and that the degrees of heat may be compared uniformly in different experiments, the bottom of the rod must always be immersed to the same height in the matter to be examined. On that account there is a mark made quite round the rod, $1\frac{1}{2}$ inch from the bottom B. For the deeper the rod is immersed into any matter, it will be lengthened the more by the same degree of heat. EF is the lever which turns upon the axis G. At F is fastened a string, which, passing twice round the pulley H, has a weight I hanging to the other end of it, of about $\frac{1}{2}$lb. being enough to keep the string always stretched. At the other end E of the lever is hung another weight L, which must be heavy enough, not only to counterbalance the larger arm GF, but press down on the point A with a weight sufficient to keep it steady. MNO is the back part of the plate, like the dial-plate of a clock made of brass, the front of it being as in Figure 3. The pulley H turns on an axis C, in Figure 3, which goes through the plate, and on the other side or front of the dial-plate carries a hand or index AB.

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* This is a very important and useful warning to the tyro in chemistry, and cannot be too highly appreciated. The practical chemist is sufficiently aware, from daily experience, of its truth; and willingly admits his conviction of it. Coxe.

† That is in Great Britain; it is likewise the one principally employed in the United States. Coxe.

Iron being a metal very ill adapted for frequent exposure to heat, in consequence of its great incombustibility, Guyton Morveau has lately proposed to substitute a rod of platinum instead of iron. We do not consider it as worth while to give a particular account of his instrument; but the reader who is inquisitive upon the subject, will find it described in the *Annales de Chimie*, vol. xlvi. p. 276.

But the most ingenious, and the best and most convenient method hitherto thought of for measuring high degrees of heat, was contrived by Mr Wedgewood, and the apparatus is well known by the name of *Wedgewood's pyrometer*. It consists of small cylindrical pieces of porcelain clay, carefully made of a determinate size, and baked in a low red heat. He employed for the purpose a particular bed of Cornish clay. This clay was first diffused through water, and the liquid passed through fine lawn. The clay was then suffered to subside and to dry. It is mixed with about $\frac{2}{9}$ths of its weight of water, kneaded into a paste, and formed into small pieces, in little moulds of metal, $\frac{6}{10}$ths of an inch in breadth, with the sides pretty exactly parallel; $\frac{4}{10}$ths of an inch in depth, and 1 inch long. These pieces, when perfectly dry, are put into another iron mould or gauge, consisting only of a bottom with two sides, half an inch deep, to the dimensions of which sides the breadth of the pieces is to be paired down. The constituents of the clay employed, according to Mr Wedgewood's analysis, are $\frac{3}{5}$ths alumina, and $\frac{2}{5}$ths silica.

It is the property of clay pieces, after having been baked in a red heat, to shrink permanently in their dimensions, according to the degree of heat to which they have been exposed. This diminution of bulk is the principle of Wedgewood's pyrometer. For measuring the diminution which these pieces undergo when exposed to heat, a gauge is made of two pieces of brass, 24 inches long, with the sides exactly straight, divided into inches and tenths, fixed half an inch asunder at one end, and $\frac{3}{10}$ths at the other, on a brass plate; so that one of the clay pieces, when pared down in the iron gauge, will just fit the wide end. This gauge is divided into 240 degrees, each of which, of course, is one tenth of an inch distant from the succeeding one. The wide extremity of the gauge is marked 0, and the degree at the narrow extremity is marked 240°. Let us suppose a clay piece to be exposed for a few minutes to the heat of a furnace, and to have been diminished in bulk by the heat one-fifth part. It is obvious, that when applied to the gauge, it will slide up just one-half of the whole, and will stop over against the degree marked 120°, indicating the heat of the furnace to have been 120°.

Wedgewood, by a very ingenious set of experiments, contrived to connect his pyrometer scale with that of Fahrenheit. He found that 0, on his scale, corresponded to $1077\frac{1}{2}$° of Fahrenheit, and that every degree of his pyrometer is equal to 130° of Fahrenheit. Hence, 240° Wedgewood, or the extremity of the scale, corresponds with 32277° of Fahrenheit. For the description of his pyrometer, and the experimental investigations by Wedgewood himself, the reader is referred to the *Philosophical Transactions*, 1782, vol. lxxii. p. 305; and 1784, vol. lxxiv. p. 358. Objections have been made to the accuracy of Wedgewood's pyrometer, from various quarters; but none of the objections which we have seen are warranted by accurate experiments.*

2. Some very accurate instruments for ascertaining the

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* We possessed a Wedgewood's pyrometer, and think we ascertained that the contraction of the clay pieces are not comparable, in an unexceptionable manner, by the following experiments:

Out of 100 of the clay pieces which accompanied the instrument, we selected six pairs which were most equal in length and weight. In company with the late professor Woodhouse, each pair was separately exposed to heat, until the crucible became white. When the pieces became cold, they were again measured and weighed: but no two of the six pairs were found to have undergone expansion of solid bodies by heat, have been invented by Ellicott, Smeaton, and Ramsden. For an account of these, we refer the reader to the *Philosophical Transactions*, 1736, vol. xxxix. p. 297; and 1751, vol. xlvii. p. 479; and 1754, vol. xlviii. p. 598.

3. For containing freezing mixtures, it is best to employ a double vessel of tin-plate, which, in consequence of the confined stratum of air, prevents the external atmosphere from acting so speedily on the mixture, and destroying its efficacy. Several convenient enough vessels for such purposes have been figured and described by Mr Walker, in the *Philosophical Transactions* for 1795, vol. lxxxv. p. 270.

4. For ascertaining the specific heat of bodies, or the capacity of bodies for heat, a very simple method was employed by Meyer. And from the subsequent experiments of Leslie and Dalton, there is reason to believe that the method is accurate. He took equal bulks of the bodies whose specific heats he wanted to know, heated each to a given temperature, and then allowed them to cool a given number of degrees. The time of cooling in seconds multiplied into the specific gravity of each body gave its specific heat. When liquids are the subjects of experiment, they must of course be confined in a vessel. The specific heat of this vessel must be previously determined, and the effect which it has upon the rate of cooling of the liquid must be attended to, otherwise the results obtained will be inaccurate.

The apparatus employed to ascertain the specific heat of bodies by mixture, by Black, Wilke, Crawford, &c. requires no description. But there are two pieces of apparatus connected with this subject, of so complicated a nature, that they will require to be particularly noticed. The first of these is the apparatus contrived by Crawford, for determining the specific heat of gaseous bodies: The second is the instrument invented by Lavoisier and La Place, for ascertaining the specific heat of bodies, by the quantity of ice which they are capable of melting. To this instrument they gave the name of *calorimeter*.

Dr Crawford's very delicate apparatus for determining the specific heat of the gases, was the following: AB, CD, Fig. 4, represent two slight brass cylindrical vessels, of equal weights and capacities; the weight of each was 7 ounces, 3 drachms, and 38 grains, troy; the length, $8\frac{7}{8}$ inches; the breadth, $2\frac{3}{8}$ inches near the upper extremity, and $2\frac{5}{8}$ inches near the bottom. They were each capable of containing 20 ounces troy of water; and, consequently, the solid contents of each is 37.91 cubic inches. These cylinders terminate in the small tubes *ls*, *rk*, at the extremities of which are fixed the brass cocks *s* and *k*. These cocks are joined to the cross bar MN, which consists of two elastic brass plates that are screwed together at the middle, but are capable of being separated from each other to a little distance at their extremities; in consequence of which, the necks of the cocks that are fixed to the stems of the brass vessels, can be slipped in between them, where they are lodged in grooves formed for receiving them, and are made fast by small screws that pass through the extremities of the plates. To the middle of the cross bar is fixed a square socket, the inner surface of which is finely polished, and which is of such a size as to be accurately adapted to the polished upright bar EF, and at the same time easily moveable upon it. At equal distances from the upright bar, are placed the tinned vessels, GH, IK, that have a little more than double the capacity of the brass cylinders. The distance of these vessels from the upright bar are so adjusted, that when the cylinders are made to descend, they shall be directed by the bar and socket precisely into the centres of the tinned vessels; and when, in descending, they have arrived at one-eighth of an inch from the bottoms of those vessels, they are stopped by means of a pin fixed in the upright bar at the point *d*. The cylinders being made for the purpose of receiving the gases whose specific heats were to be ascertained, were made as slight as was consistent with standing the external pressure of the atmosphere when exhausted. With a view to diminish the inaccuracy unavoidably occasioned by the heats communicated by the cocks *s* and *k*, and by the cross bar MN, the tubes *ls*, *rk*, were made very slight, and of a considerable length; the distance from the cocks to the brass cylinders being $4\frac{7}{8}$ inches. From the length and slightness of the tubes, it was found that the brass cylinders could not be kept sufficiently steady in the centres of the tinned vessels by the cross bar MN. For this reason, another bar, OP, was added, a lateral view of which is given in Fig. 5. In this figure, *ab* represents a narrow brass plate, of a considerable thickness, to which is fixed the socket *op*, moveable upon the upright bar formerly described. The two thin plates *cn*, *dk*, are riveted to *ab*, at the points *o* and *p*; and their extremities, *l* and *m*, are formed into grooves, which are adapted to one half of the circumference of the stems of the brass cylinders, to the other half of which are closely applied two brass pieces, which are also grooved, and which are fastened to the plates by the screws *r* and *s*. The two male screws, *g* and *h*, are passed through the extremities of the thick plate *ab*. These are introduced into two corresponding female screws, in the thin plates *cn*, *dk*, by means of which it is evident, that the latter may be made to approach nearer to the former, or to recede to a greater distance from it. This motion is communicated to the stems of the brass cylinders, by means of which they are adjusted in such a manner, as that when they are introduced into the water, they shall be accurately in the centres of the tinned vessels, where they are kept steadily in their proper positions. The superior and inferior cross bars are connected together by a thin plate of brass, which passes from the socket of the former to that of the latter, and which is made fast by means of screws. The screw that fixes this plate to the socket of the inferior bar, is of such a length, as when screwed home, to extend to a small distance beyond its inner surface, by which means the apparatus, in descending along the upright bar, may be fastened to any part of it.

To each of the tinned vessels (see Fig. 4.) two very small mercurial thermometers are fixed, which are of different lengths; the larger reaching as far as the centre of the vessel; the shorter extending a little lower

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an equal contraction, and the difference of their weight was greater than before the experiments.

When the manner in which the clay pieces are formed is considered, (as mentioned in the text,) no uniform power being employed to compress them, we think it must, *a priori*, be concluded, that there can be no uniformity in the contraction of the different pieces, as it appears highly probable that the decrement of their contraction must be influenced by the quantity of clay in a given length, even if their thickness and weight should be considered as unimportant. HEMBEL, jun.

than the surface. The thermometers *ab* and *cd*, which indicate the heat in the vessel GH, are applied to a thin plate of ivory *ef*, which has two scales divided upon it, one for each thermometer. This plate is fixed to the vessel by means of a clamp *gh*, the shank of which consists of two thin elastic brass plates, united at the top, and separable from each other at the lower extremity. For the purpose of admitting the thermometers, the projecting part *ov*, having the figure of a parallelopiped, was added to the tinned vessel. The exterior side of this projection is received between the plates of the shanks described above. These plates are closely applied to it, by means of their elasticity, in consequence of which the clamp is steadily retained in its position, at the same time that it admits of a considerable degree of elevation or depression. Hence the depth to which the thermometers are sunk may be varied at pleasure; and, in order that this depth may be accurately known, a scale of equal parts is divided upon the exterior plate of the shank. Through the upper part of the shank is passed a small male screw S, similar to that which is used in adjusting the focus of a telescope. This is introduced into a corresponding female screw, inserted in the ivory plate, which has the thermometers fixed to it; and as that plate is suspended in the clamp by a pin, around which it has a free motion, it is manifest, that, by turning the above mentioned screw, the thermometers may be made to approach nearer the centre of the vessel, or to recede farther from it.

The two brass cylinders in this instrument were intended to hold the gases experimented upon. The gas to be used was first introduced into a tin syringe, previously filled with water. To the end of this syringe was fixed a worm, terminating in a flaccid bladder. The worm was surrounded by a mixture of salt and ice. The gas was slowly forced through this worm from the syringe, and extended the flaccid bladder. The object of this was to free the gas as much as possible from moisture, by exposing it to the cold of the freezing mixture. The brass cylinders being previously exhausted by means of an air pump, the bladder was screwed to the top of the stem, and the stop-cocks being opened, the gas rushed in and filled the cylinder.

The next object was to heat the cylinder containing the gases equally, and without moistening them. Dr Crawford's contrivance for that was the following: AB (Fig. 6.) represents a quadrangular tinned vessel, that has the two smaller vessels, CD, EF, fixed to its bottom by means of dovetails, along which they may be made to slide, and may be so adjusted, that their distances from each other shall be equal to the distances of the cylindrical vessels in which the air is contained; their size being such, that they shall be nearly accurately filled by those vessels, when the latter are introduced into them. It is therefore manifest, that warm water contained in the large vessel AB, and coming into contact with the external surfaces of the smaller vessels CD, EF, will necessarily communicate a part of its heat to those vessels, and to the cylinders which are placed in them. If the cylinders had been heated by being immediately immersed in warm water, a quantity of moisture would have adhered to their sides, which would have produced an inaccuracy in the experiment. Two small thermometers, *l*, *r*, are introduced into the brass cylinders, (Fig. 4.) in order to indicate the heat which the gas contained in them requires. Each of the brass cylinders is enveloped in flannel, in order to confine the heat as much as possible.

Such is the ingenious apparatus of Dr Crawford. It remains to say a few words upon the way in which his experiments were conducted. Suppose he wanted to determine the relative specific heats of common air and oxygen gas, he filled one of the cylinders with common air, and the other with oxygen gas. The cylinders were both heated equally by the contrivance exhibited in Fig. 6. They were then suddenly let down into the tinned vessels, IK, GH, (Fig. 4.) containing each an equal quantity of water of the same temperature. They were allowed to remain for about 15 minutes, and being withdrawn, the water in the tinned vessels was agitated for a little, and its temperature taken. As the weight and temperature of each brass cylinder and its flannel covering was the same, if there was any difference in the temperatures of the water in the two tinned vessels, that difference must have been owing to the heat communicated by the gas in the one cylinder being greater than the heat communicated by the gas in the other cylinder. Suppose, for example, that the water exposed to the action of the cylinder containing the oxygen gas, were one degree hotter than the water exposed to the action of the cylinder containing the common air; it follows from this, that 37.91 cubic inches of oxygen gas, when they cool a certain number of degrees, give 1° more heat to a certain weight of water, than the same bulk of common air. From the knowledge of this fact, the capacity of each for heat is easily inferred. Such was the ingenious method employed by Dr Crawford; and the care and address with which his experiments were conducted cannot be too highly praised. At the same time, we are afraid that his results are not near approximations to the truth; and that the unavoidable errors of experiment, when the whole difference between the temperatures amounts only to one or two tenths of a degree, are such, as to render every result obtained by his method of little value. Though the time which a body takes in cooling, when placed in the different gases, does not depend upon their capacity for heat alone, yet as that capacity influences the result, valuable inferences may be drawn from experiments made in that way; and they promise to lead ultimately to a much more precise knowledge of the capacity of the different gases for heat, than any other method which has been hitherto thought of.

The *calorimeter* is an instrument contrived by Lavoisier and La Place, for determining the specific heat of bodies, and was first described by them in the Memoirs of the French Academy for 1780, p. 355. Lavoisier afterwards re-published the account of it in his Elements of Chemistry, Part III. Chap. iii. It was founded upon this well known fact, that if a hot body be surrounded by a sphere of ice, none of the heat can penetrate through the ice, but will be all employed to melt it. Hence the quantity of ice melted ought to measure the quantity of heat which has escaped out of the hot body, and, of course, gives us the relative specific heats of all the bodies examined in this manner. The calorimeter is represented in Fig 7. It consists of three vessels enclosed within each other. The innermost of these, *ffff*, into which the substance submitted to experiment is put, is composed of a grating, or cage of iron wire, supported by several iron bars. Its opening, or mouth, is covered by a lid, which is composed of the same materials. The middle cavity, *bbbb*, is intended to contain the ice which surrounds the interior cavity, and which is intended to be melted by the heat of the substances employed in the experiment. The ice supported by the grate, *mm*, at the bottom of the cavity, has under it a sieve. In proportion as the ice contained in the middle cavity is melted by the heat disengaged from the body placed in the interior cavity, the water runs through the grate and sieve, and falls through a conical funnel into a receiver placed below it. The external cavity, *aaaa*, is filled with ice, to prevent any effect upon the ice in the middle cavity from the heat of the surrounding air; and the water produced from it is carried off by the pipe ST, which shuts by means of the stop-cock *r*. The whole machine is covered with a lid, made of tin-plate and painted.

When this machine is to be used, the outer and middle divisions are filled with pounded ice, well rammed, and without any vacuity. The machine is then opened, and the substance, submitted to experiment, being placed in the interior cavity, it is instantly closed. After waiting till the body is cooled down to the freezing point, the water which has run out from the middle cavity is carefully weighed. This water obviously measures the quantity of heat which has escaped from the body experimented upon, during its cooling to the freezing point. For the various precautions employed by the French philosophers, during their experiments with this apparatus, to ensure accuracy, the reader may consult Mr Lavoisier's account of them in his Elements of Chemistry, to which we have referred above. The only person in this country, who has attempted to repeat the experiments of Lavoisier and La Place, was the late Mr Wedgewood. In his trials a phenomenon took place, which prevented him from being able to draw any conclusions from his trials. The water which ran from the melted ice actually froze again, though the temperature of the ice was at 32°. Such a phenomenon, unless it can be obviated, obviously makes the calorimeter, ingenious as the contrivance at first sight appears, entirely useless as an instrument for investigating the specific heat of bodies. The freezing of the water seems to be owing to the cold produced by its evaporation. From Mr Wilson's experiments, it appears that the evaporation of ice is greatest, when its heat is 32°. Now, as the temperature of the water, produced by the melting of the ice in the calorimeter, cannot much exceed 32°, it is obvious that a very slight diminution of temperature by evaporation will be sufficient to begin congelation; and when congelation once begins, the attraction of the spiculæ of ice formed for the particles of water, will probably tend to increase the quantity of ice.

There are no other apparatus connected with heat, which seem to require particular description. The contrivances of Mr Leslie and of Count Rumford possess great ingenuity; but are so simple, that the reader can find no difficulty in understanding them.

Chap. II.

Apparatus for Experiments with Gases.

This branch of Chemistry requires by far the most expensive and complicated apparatus. We shall satisfy ourselves with describing the most important requisites. Almost every chemical experimenter has added something of his own to this department of chemical vessels. Hence it would be an endless and a useless task to describe every thing that has been proposed, or even brought into use.

1. The first requisite is a water-trough, for preparing the gases, and for containing the vessels in which the gases are confined. These are of various sizes, according to the extent of the laboratory, or the objects which the proprietor has chiefly in view: the largest are made of wood and lined with lead, about four feet long, three wide, and two deep. They have a wooden shelf fixed about three inches under the surface, upon one side of the trough, for holding the glass jars. This shelf is perforated with holes, for the conveniency of pouring the gases from one jar to another; and these holes are usually funnel-shaped, having their wide mouth at the under side of the shelf. This trough, when to be used, is to be filled with clean water. Water-troughs are often made much smaller than this. In that case, they are only made of tin-plate and japanned; or what would be much better, and perhaps even ultimately cheaper, would be to make them of copper, which ought likewise to be japanned. A trough of this kind, two feet long, sixteen inches wide, and as much in depth, with a shelf soldered to one of its ends, also of copper, and placed about two inches under the surface, would answer a great variety of purposes, and, from its small size, would be convenient, as it could easily be carried from one place to another, even when full of water. We shall give a figure of the small tinned iron water-troughs that are commonly used in London. *a* (Fig. 8.) is a deep oblong trough, made of thin tinned iron, well japanned, generally 18 inches long, 9 broad, and 14 deep. About 3½ inches from the top is a shelf of the same material, extending entirely across the trough, and rather more than a third of its length. This shelf is given inverted in Fig. 9. to show an oval rim projecting from it, in the centre of which are two small holes, the use of which is to secure and convey the gas into any vessel set upon it, (as the bottle, Fig. 8.) This shelf has also two larger holes to receive two bottle supporters. Fig. 10. and *b*, Fig. 8.

2. To prepare the gases, various vessels may be employed, according to the nature of the gas wanted. Small retorts, with long beaks, (see Fig. 11. and 12.) answer very well; or flasks, with bent tubes ground into them. (See Fig. 13, 14, and 15.)

3. To receive the gases as they come over, the most simple apparatus consists of glass phials, with ground stoppers, made perfectly air tight. These may be filled one after another, and, the stoppers being fitted in, may be placed with their mouths inverted in a vessel of water, and kept till wanted; or glass jars may be employed, open below and shut above, as those represented in Fig. 16, 17. Plate CXLI.; and in Fig. 1. Plate CXLII.

4. When the quantity of gas prepared is considerable, it is necessary to be provided with larger vessels than any of those already mentioned, to contain it. Such vessels are usually made of tin-plate japanned, or partly of tin-plate, partly of glass, and they are known by the name of *gazometers*, *gas-holders*, air-holders. Their construction is very various, according to the fancy of the chemist, or the object which he has in view. We shall give a description of some of the most useful.

Fig. 3. and 4. represent the outline of a very convenient vessel for holding oxygen gas. It is made of tin-plate, well japanned, both withinside and without. It may be of any size: the vessel, of which this is a representation, held about 2000 cubic inches. It is a cylindrical vessel, close on all sides, and ought to be pretty strong to resist the pressure of the atmosphere, which tends to force out gas, or to force in air, according to the changes in its density which take place. It is furnished with three mouths, A, B, C. The first at the top, the second at the side as high up as possible, the third at the bottom. A and B are each provided with a stop-cock. The stop-cock A is soldered into the tube D, which goes to the very bottom of the vessel to which it is soldered, in order to increase the strength of the air-holder. The tube D, towards its bottom, is perforated with a number of holes. To the extremity of the stop-cock B, the piece of bent tube E is ground, so as to be air-tight, but to move freely round the extremity of B, which is turned up to receive it. And to the extremity of E, the long tube F is likewise ground, so as to be air-tight, yet capable of moving freely. These two tubes, by their motion, form an universal joint, so as to enable the operator to turn the extremity of the tube F any way he thinks proper. The mouth C consists of a tube about an inch in diameter, introduced into the vessel, near the bottom, at an angle of about 45°. It is provided with a stopper, which screws into it and shuts it close. G is a glass tube, fixed into the top and bottom of the air-holder, and graduated. The use of it is to show the operator how much gas the vessel contains. It is a large glass conical vessel, made to fit into the upper end of the stop-cock A.

A few words will explain the method of using this vessel. The first step is to fill it with water. For this, the mouth C must be shut, and the stop-cocks A and B opened. Water is then poured into the glass vessel H, which, running down the tube D, makes its escape through the holes in its bottom, and fills the vessel, while the common air makes its escape by the stop-cock B. When the air-holder is quite full of water, the stop-cocks A and B are to be shut, the glass vessel H removed, and the stopper of the mouth C removed. As the vessel is completely air-tight, the water cannot make its escape by the mouth C, because the angle at which it enters the vessel, prevents any common air from entering. The mouth of the tube connected with the apparatus for furnishing oxygen gas being introduced into C, the gas rises gradually to the top of the air-holder, and the water runs out by the mouth C. When the process is finished, the mouth C is to be shut; and if the vessel be a good one, the gas may be kept in it for many months without undergoing much alteration. Suppose we want a portion of the oxygen gas out of this air-holder, for any particular purpose, we have only to introduce the point of the tube F into the mouth of the vessel which we mean to contain the oxygen gas, and then to pour a quantity of water into the glass vessel H, which must be replaced for the purpose. The stop-cocks A and B being opened, the water runs down the tube D, and forces the oxygen gas to escape through the tube F. By this method any quantity of the gas wanted may be easily procured.

Another gazometer, of a different construction, is represented in Fig. 3, 4. which are merely different views of the same vessel, and the same letters in both refer to the same parts. Like the former, it is made of tin-plate, well japanned, both within and without. *aa* is the outer pail, or circular vessel, with a spout at top. Two tubes, *d* and *e*, (each filled with a stop-cock externally), are firmly soldered to the sides of the pail: the tube *d* penetrates at the bottom of the pail, and proceeds to the centre, where it joins the termination of the tube *e*, which enters the top of the pail, and proceeds downwards; and from the place of junction, the upright tube *g* rises through the middle of the pail, a little above the level of its upper rim. The vessel *b* is a cylinder, open only at bottom, and of less diameter than the pail into which it is inverted, and can move up and down freely. This cylinder has a solid stem, *c*, which passes through a hole in the wooden cross-bar of the frame, round the top of the pail, and serves both to keep the cylinder in a perpendicular direction when moving up and down, and to indicate the quantity of inclosed gas by the graduation on its surface. The weight of the cylinder is counterpoised by weights put into a scale dish, which is connected with the top of the cylinder by a cord and pulley. The pail has besides an opening through its bottom, closed by a separate stop-cock, *f*, by which the water may be drawn off. The whole apparatus is conveniently supported on a heavy wooden stool. To use this gas-holder, first let the cylinder fall to the bottom of the pail, and pour water into the spout of the latter till it is quite full; then shut the cock *e*, and open *d*, and connect with it the tube which conveys the gas immediately from the retort or other vessel in which it is produced: or, if more convenient, shut *d*, and convey the gas through *e*. The gas rises through the upright tube *g*, to the top of the cylinder *b*, which it gradually lifts up; and care must be taken to keep in the scale-dish sufficient weight to allow the cylinder to move with perfect freedom. When all the gas wanted is obtained, shut the stop-cock, and it remains in the air-holder till wanted. To take out any of it, connect with either of the stop-cocks a bent tube, and insert the mouth of it into a vessel destined to receive the gas, remove the weights out of the scale-dish, and open the stop-cock. The weight of the cylinder *b* will press out the gas and fill the vessel.

As the weight of the cylinder is constantly increasing during the whole of its rise out of the water, it is necessary to be continually adding weights to the scale-dish to compensate for this increase, otherwise the gas will be more and more compressed, and at last will cease to enter altogether. Or this increase may be still better compensated, by making the cord pass over a spiral pulley, by means of which, the weight in the scale-dish will act more and more powerfully as the cylinder rises, and thus compensate the increase of its weight.

Many other gas-holders have been contrived by chemists; but it is needless to describe them, as they may be essentially referred either to one or other of the two which we have figured.

5. Many gases are absorbed with such avidity by water, that it is necessary to prepare them over mercury. Hence a mercurial trough is also requisite for all those who wish to investigate the properties of gaseous bodies with any thing like success. Mercurial troughs are very various in their shapes. One of the most usual and best shapes is represented in Fig. 5. It may be made of mahogany, or it may be cut out in marble; or what is now most common, it may be of iron, and covered externally with wood. *a* is the cistern filled with mercury, in which the glass jars are to be filled, and then slid upon the shelf visible in the figure. The glass jars used with this trough must be smaller than those used for the water trough, and they ought to be stout. As they are liable to be overturned by the weight of the mercury, care must be taken to fix them.

Mercurial gas-holders are used, made on a similar plan with the second kind of gas-holders described above. The outer case is cast-iron. There is an inner cylinder of cast-iron, at a little distance within the interval between them, filled with mercury; *v*, a glass jar, is made to move freely between both, and to receive the gas. The reader will easily conceive a gas-holder of this kind without a figure.

6. It is necessary to be in possession of a method of measuring the bulk of our gases with accuracy. For this purpose, the jars into which they are received should be accurately graduated. The best graduation is into cubic inches, and their decimal parts. The experimenter should perform this graduation himself, otherwise he can very seldom depend upon its accuracy. He should first provide himself with some glass tubes, shut at one end and open at the other, and of as equal a bore as possible. Some of them should be $\frac{1}{4}$th inch in width, others $\frac{1}{8}$th, and some may be as wide as $\frac{5}{8}$ths, or even $\frac{3}{4}$ths of an inch. A long ribbon of white paper, about $\frac{1}{5}$th inch wide, should be pasted along the whole length of the tube by means of gum water. That it may adhere to the glass in every part, a quantity of twine may be wrapt round it while wet, and the tube may be set aside till next day, when the paper will be found adhering to it closely in every part. The tube is now set in an exact perpendicular direction with its open mouth uppermost. We shall suppose it our intention to graduate this tube into hundred parts of a cubic inch. The best method of doing this is the following:

Provide a quantity of mercury, and ascertain its specific gravity with accuracy. This being known, it is easy to ascertain the weight of $\frac{1}{100}$th cubic inch of mercury. For example, the mercury which we are in the habit of using is of such specific gravity, that $\frac{1}{100}$ of a cubic inch weighs 34.46 grains. Weigh out this quantity of mercury, and introduce it into a tube terminating in a point, and of a bore as narrow as possible, but still allowing the mercury to run out freely. The mercury should occupy about 3 inches in length of it from the pointed end. Mark carefully with a file the part of the tube to which the mercury rises. This tube, thus prepared with a pair of good scales, will enable you to graduate your tube with considerable rapidity. Pour the first $\frac{1}{100}$ cubic inch of mercury into your tube, observe its surface, and draw a fine line with a pencil upon the ribbon of paper over against this surface. Draw up into your pointed tube, by means of the mouth, a quantity of mercury, till it just rises to the mark. Put this quantity into your scales, and, if you manage matters with tolerable dexterity, you will find that it will weigh exactly 34.46 grains. Pour this into your tube, and draw a pencil line over against its surface. Proceed in this way till you have filled your tube to the top. By this method, you have got your tube graduated upon the ribbon of paper. To graduate it upon the tube itself, which is requisite, procure some small triangular files, and moistening one of the angles, draw it along the pencil marks upon the paper. You soon cut through the paper, and make an impression upon the glass tube; and, if you manage matters with address, you do not injure the adhesion of the rest of the paper to the tube. At every 5th degree, make the line upon the tube somewhat longer than the preceding 4 lines; and make the line still longer at every 10th degree. Having thus marked the degrees upon the whole length of the tube, dip it into water, and wash off the paper. If you have used the file properly, you will now find the lines engraven upon the tube very neatly and distinctly. You now with a diamond write the numbers 10, 20, 30, &c. opposite to the respective lines upon the tube.

Large jars are to be graduated in the same manner, only you divide them into cubic inches instead of $\frac{1}{100}$th of cubic inches. It is necessary also to use water instead of mercury. As a portion of the water adheres to the vessel in which you weigh it, you must make an allowance for this quantity, otherwise your marks will represent something less than cubic inches. This error, though small, becomes extremely sensible after being repeated one, two, or three hundred times.

7. Suppose it required to take a small quantity of gas out of a jar standing over water, and introduce it into a vessel standing on the mercurial trough, without taking any of the water along with it, or even wetting the inside of the vessel. This may be done by a very simple instrument, first contrived by Mr Cavendish, and represented in Fig. 6. It consists of a glass tube, graduated into $\frac{1}{100}$ths of a cubic inch, open at both ends: One end, however, drawn out to a capillary tube. This tube being first filled with mercury, is to be introduced into the jar standing on the water trough, with the finger shutting up closely the end A, which must be undermost. When fairly within the jar, you withdraw the finger a little from one side of A, and let the mercury run out, till its upper extremity comes opposite to the degree, marking the quantity of gas which you want to take out. The finger immediately resumes its place. By this contrivance, the gas is made to enter at the capillary end B, and to fill what part of the tube you have a mind. You then withdraw the tube from the water trough, holding your finger in its position all the while, and wipe the outside of the tube dry with a cloth. You then carry it to the mercurial trough, place the point B under the jar or tube into which you wish to introduce the gas, and bending the tube, so that the whole of A is under the surface of the mercury, and the end A somewhat lower than the end B; remove your finger from A, the mercury runs in, and the gas makes its escape from the capillary end B, and enters into the vessel prepared for its reception.

8. The next object, after being able to measure the bulk of gases, is to ascertain their specific gravity. To do this it is necessary to be provided with a good air pump, or at least with an exhausting syringe. Very extensive apparatus were contrived by Lavoisier and others for weighing gases; but they are unnecessary, and do not even answer so well as a much more simple and cheap contrivance which we shall now explain. Let a Florence flask, or one of those thin glass flasks that come to this country from Italy filled with oil, be well cleaned, and fitted with a cap and brass stop cock, both as light as possible. This flask, by means of an intermediate short brass tube properly furnished with screws, is made to fit to a jar standing over water, and furnished with a stop cock at the upper end, and to another jar of the same construction standing in the mercurial trough. Suppose we want to take the specific gravity of a gas standing over water. We first weigh the flask and stop-cock with as much accuracy as possible. We then exhaust it of air and weigh it again, noting the loss of weight, which indicates the quantity of air drawn out of the flask. Let us suppose this loss of weight to amount to 10 grains. We now screw the flask to the jar containing the gas to be weighed, and turning the stop-cocks, the gas rushes in and fills the flask. We must take care that no water

or mercury make its way into the flask along with the gas. This is best guarded against, by filling the intermediate brass tube with cotton. We now weigh the flask a third time. If its weight be the same as at first, then the gas is of the same specific gravity as common air; if it is lighter, the gas is lighter than common air; if it is heavier, the gas is heavier than common air. Suppose, for example, that the flask wants 5 grains of its original weight. We infer, that the weight of air is to the weight of our gas as 10 to 5, or that its specific gravity is one half of that of common air. By this easy method we determine the specific gravity of any gas, taking the specific gravity of air at 1.00; and knowing that at the temperature of 60, and when the barometer stands at 30 inches, 100 cubic inches of air weigh 30.5 grains, we can easily deduce from our experiments the absolute weight of our gas. No correction is necessary, either for temperature or for the height of the barometer, because all gases undergo the same change in bulk by heat and pressure.

9. One essential requisite for taking the specific gravity of gases, is a good balance. The one which we employ was made by Mr Cuthbertson of Glasgow, and weighs easily to the hundredth part of a grain, so that we are sure of our specific gravities of gases to two decimal places, but no farther. As Mr Cuthbertson's beams differ in several particulars from any others that we have seen, we shall give a figure and short description of one of them, and mention some of its excellencies and defects. See Fig. 7.

The beam *ab* is made of cast steel; and, as will be seen by the Figure, is very slender, though of considerable length. To prevent it from warping or bending, the two slender wires *c*, *c* are riveted into the ends of the beam, and screwed tight to the upper end of the tongue of the balance. These wires, or *stays*, constitute the chief difference between this and other balances. There is nothing peculiar in the construction of the other parts. The sensibility is owing chiefly to the great length of the beam. The principal defect of this balance, is the way in which it is suspended to the top of the glass case by means of the hollow brass cylinder *d*. A solid cylinder of brass, attached to the top of the balance, plays in this hollow cylinder; and by means of the string *e*, and weight *f*, the balance is raised above the stand, or let down to it at pleasure. This mode of suspension gives such a tendency of shaking to the balance, that the process of weighing is very tedious.

10. Many of the gases are of an inflammable nature, and it is by their combustion with oxygen that the inferences are drawn with respect to their nature and constituents. The combustion of the gases requires a peculiar apparatus, which it will be requisite to describe. A good electrical machine is the first requisite. This may be either a plate machine, according to the more modern and fashionable construction, or a cylindrical one. All that is wanted is, that it should give out strong sparks when in proper order; for burning the gases, a very strong glass tube is used, about four inches long, and ¾ths inch wide, shut at one end, and open at the other. This tube is graduated, and should hold about three cubic inches. Two holes are drilled in it opposite to each other near the top, and into these are cemented two brass pins, which project into the tube, and approach near enough to transmit a spark from one to the other externally. These pins terminate in small rings. The mixture of gases being put into this tube, it is firmly fixed down in a water or mercurial trough by a strong iron screw. The brass pins being now connected with the electrical machine, a spark is made to pass from the one to the other, which sets the gas on fire.

When this experiment is made over mercury, the sudden expansion produced by the combustion of the gas is apt to drive some of the mercury out of the trough. To remedy this inconvenience, the French chemists usually put a stop-cock at the bottom of their detonating tube, which they shut before passing the electric spark. But this is a bad method, as the shock is very apt to break the glass tube, however strong, unless the quantity of gas burnt be very small. Mr Pepys has contrived the apparatus represented in Fig. 8, which answers very well. The detonating tube *a* is supported by a strong iron stand *c*, which has a strong spring near the foot, which draws out after the manner of a steelyard when the concussion is given. The inconvenience may be remedied also, by placing the detonating tube in a copper cylindrical vessel about 3 inches deep, and filled with mercury. The depth of the mercury prevents the concussion from being so violent as to drive out and spill the mercury.

11. It may be worth while to describe here an apparatus contrived by Dr Henry, for the slow combustion of inflammable gases. This apparatus is represented in Fig. 9. *a a a* is a pneumatic trough filled with water; *n n* a large glass jar likewise containing water. *c c* is a stand, to which the graduated air-holder *b* is made fast, by means of the moveable arm *d d*. *o o* is another air-holder, fixed by the plugs *v v* into the glass jar *n n*. It is furnished with the stop-cocks *q*, *r*, and the bent tube *s*, which passes into the water cistern, and passes up a certain way into the air-holder *b*, terminating in the iron burner *t*. The air-holder *b* is closed at top by a brass cap *e*, and stop-cock *f*, the lower orifice of which is tapped internally, for the purpose of receiving a small screw at the end of the copper wire *g*. The gas to be burnt is put into the air-holder *o o*, while the air-holder *b* is filled with oxygen gas. By opening the stop-cocks *q*, *r*, and letting water run into the jar *n n*, the gas is gradually forced through the tube *s s* into the air-holder *b*. An electric spark sets it on fire at *t*, and it continues to burn till the oxygen or the inflammable gas are wasted. The rapidity of the flow of water is regulated by the cocks *x*, *z*. The water makes its way into the air-holder by the holes *w*, *w*, drilled in the plate to which its bottom is ground. *u* is a wire to conduct the electricity; and *h* is the wire which conducts the electricity from the receiver *i*.

12. In many experiments, retorts or flasks furnished with stop-cocks are requisite. They are first exhausted by means of an air pump, and then filled with the gas to be experimented upon. Thus all contact of water may be prevented, and the gases may be previously dried at pleasure.

13. The various tubes used by chemists under the name of eudiometers, do not seem to require a particular description.

Chap. III.

Apparatus for Experiments on Liquids.

Several of the vessels employed in experiments on liquids, as retorts and flasks, have been already mentioned. We shall take notice of a variety of other vessels. They are in general so simple, that they will be easily understood without much explanation. Fig. 10. represents a balloon glass receiver; and Fig. 1. a matrass, with a wire twisted round its neck to hold it by when hot. Fig. 2. is a glass funnel. Fig. 3. a precipitating vessel. Fig. 4. represents a copper still fitted into a furnace, with the worm and refrigetory. *a* is the still, *b* the head, *c* the worm passing through the refrigetory, which is supposed to be full of water. Fig. 5. is a glass alembic for distillation, fitted with its head and receiver. *a* is the alembic, *b* the head, *c* the receiver.

Figure 6. represents a Woulfe's apparatus fitted up for distillation: *a* is a stand, *b* a lamp, *c* a retort fixed above the lamp by means of the ring on the stand, *d* the receiver standing on the support *e*, *f* a tube of safety passing from the receiver to the jar *g*, *h* a tube passing from the jar *g* to the jar *i*. These jars may be continued at pleasure, and the tube from the last jar may pass under a glass vessel standing in a water or mercurial trough, to receive any gas that comes over. Each of the jars contains a quantity of water, into which the tube that enters into it is plunged. In the bend of the tube of safety there is a little water or mercury, to shut out the communication of the external air. The original of this apparatus must be referred to Glauber, who has represented it in his work on furnaces. The improvement introduced by Woulfe was to have a considerable quantity of water in each jar, by means of which, in many cases, a great deal is saved that would otherwise be lost. All the joinings are to be well luted. The tube of safety prevents any bad accident from happening in the course of the distillation. If there happen to be an absorption of air within the apparatus, as is often the case, the external air rushes through the tube of safety and fills up the vacuum. These apparatus are fitted up in a variety of ways by different chemists; but, after the remarks already made, they may be easily conceived by our readers without any farther description.*

The other vessels employed in experiments on liquids do not seem to require any particular explanation. They will be easily understood by any person who attends to the properties of the various liquids subjected to experiment.

Chap. IV.

Apparatus for Experiments on Solids.

The first and most essential piece of apparatus for experimenting on solid bodies, is the furnace. The French have a great advantage over British chemists in the light, cheap, stoneware furnaces, so easily procured in Paris. They are so light as to be easily manageable, and so cheap as not to be beyond the purchase of the poorest experimenter. It is rather surprising that they have not been introduced into Great Britain. They might be constructed with the utmost ease by our potters and crucible makers; and the sale, from the many advantages which they possess, could not but be extensive. When properly hooped with iron on the outside, they would, probably, answer very well for our pit coal fuel.

The best account of furnaces in any English book that we have seen, is in Lewis' *Philosophical Commerce of the Arts*. The practical chemist would do well to consult that excellent treatise. A great variety of furnaces are employed by chemists; but the *wind furnace* may be made to answer almost every purpose. It may be raised to as high a temperature as the blast furnace, by making its chimney of the proper height. We have seen a heat of 160° Wedgewood produced in a very small wind furnace, and iron melted in it with great facility. We shall give a short description of the most improved form of Black's portable wind furnace, the one commonly employed in this country. Figure 7 is an outline of the furnace, and Fig. 8. a section of it.

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* A Woulfe's apparatus with tubes of safety may answer very well for demonstrations at a public lecture: but, for processes in which considerable quantities of gas are evolved, and the saturation is to be effected under great pressure, they are totally inadequate. If the lower orifice of the tube is much immersed below the surface of the liquid, the accumulated gas will act similar to condensed air in the experiment of the hydrostatic fountain, and force the liquid out of the bottle until the orifice of the tube is exposed; then the gas will also escape; thus occasioning a double loss of products, and that whether straight or welters tubes be used.

Plate CXLII. No. 2. fig. 4. represents our method of connecting any number of bottles, by which tubes of safety are superseded; yet the liquid can be saturated with gas, by as much pressure as the tenacity of the glass will resist: with the further advantage of being able to change the surface of the liquid at pleasure, without injury to the product.

The apertures of the tubes H, K, M, O, merely perforate their respective corks; whilst the tubes I, L, N, &c. descend *very near* the bottoms of the bottles. Into the bottle C, a small quantity of water is introduced, to engage the impure gas which may come over. The bottles E and G, contain the liquid to be saturated with the gas;—a similar arrangement of long and short tubes are to be used for any additional number of bottles.

On introducing into the retort, the substance from which the gas is to be extricated, and adding an acid, an action will take place. The evolved gas will pass through the liquid in the bottles as usual. When the gas ceases to be further evolved, a condensation will take place in the retort; then the liquid in the bottles C, E and G, will yield to the pressure of the incumbent atmosphere, (acting through the aperture of the tube O,) and pass into the bottles B, D and F. But, as the apertures of the short tubes H, K and M, terminate with the lower surface of their respective corks, and the liquid in the bottles does not reach those apertures, the liquid can pass no further.

It will then be only necessary to excite a fresh action by adding more acid in the retort, when the gas will accumulate in the receiver and empty part of bottle B. When the elastic force of the accumulated gas is sufficient to support a column of the liquid, equal to the height of one leg of the tube I, the liquid will rise and pass into the bottle C, the gas will follow and pass in the bottle D, and by pressing on the surface of the contained liquid will force it over into the bottle E, after which, the liquid in F will be forced in G, when the process of saturation will go on as before.

There will be a great economy of acid, if the subsequent additions are not added until after an absorption has taken place, as the surface of the liquid will thereby be frequently changed, and the absorption of gas considerably accelerated.—For saturating water with muriatic and ammoniacal gas, or preparing hyper-oxymuriate of potash on a large scale, demijohns may be substituted for the bottles D, E, F, &c. Hembel, jun.

The same letters indicate the same parts in both figures. It consists of an oval iron case, 22 inches high, 20 in its largest diameter, and 15 in its shortest, lined with fire brick or fire clay for about three fourths of its height from the top, which part forms the body of the furnace, while the under part, which is not lined, forms a very spacious ash pit. *a a* is the body of the furnace, which is cylindrical, but a little oblique, that the flame of the fuel may heat the sand more equally than if it were a straight cylinder. The breadth of this cylinder is 8½ inches, and its height 15. The grate *c* lies across the bottom. This fire place has the following openings above the grate: The highest is the large opening at the top, which, when a sand heat is employed, receives the sand pot *i*, and, when this is not wanted, is covered by a thick iron plate lined with clay. The next opening is the elbow of the chimney *f*, which widens as soon as it takes a perpendicular direction, and for the first few inches forms a part of the iron case of the furnace, and is lined with clay. After which it is elongated by an iron tube fitted to it, and not represented in the Figures. The degree of heat is regulated by varying the length of this iron tube. The third opening *e* serves to introduce fuel, and may be employed also to regulate the heat. The fourth opening consists of two small round holes *g g*, opposite to each other on the two sides of the furnace. Through them a porcelain or iron tube is occasionally introduced, when it is required to be heated to redness for any particular experiment. The last opening *d* is intended for introducing a muffle. All these openings are furnished with thick brick stoppers, and iron plates which slide over them. There are two openings *b b* in the ash pit, which serve to regulate the draught of air, and, of course, to vary the heat of the furnace.

Fig. 9. is a muffle. This is a vaulted flat-bottomed earthen vessel, close at one end and open at the other. It is introduced into a furnace with its open end corresponding to the muffle door of the furnace, and is intended to expose small vessels to heat without being in contact with the fuel. There are usually openings in its sides to allow the entrance of heated air.

Figures 10. and 11. represent a convenient and cheap blast furnace, contrived by Mr Arthur Aikin from an idea of Dr Lewis in his Philosophical Commerce of the Arts. It consists essentially in two black lead crucibles, one of which *a* is inverted, and the other *b* is placed over it. A hole is bored in the bottom of the crucible *b*, into which the clay stopper *c* (Fig. 12.) is fixed, merely to give firmness. Eight holes are bored in the bottom of the crucible *b*, only two of which are represented in the Figures. Through these holes the air driven in by the bellows, represented in Fig. 10. fixed upon a wooden stand, makes its way to the fuel, and speedily raises a most intense heat. To protect the eyes, it is often necessary to put the crucible *e*, Fig. 13. furnished with the opening *f*, to let out the smoke, over the crucible *b*.*

Figures 14, 15, 16, 17, represent two crucibles, the one triangular, the other circular, with their lids and their supports. These supports are sometimes rolled, as in Fig. 40, and sometimes hollow as in Fig. 41. Crucibles are made of a very refractory clay. The Hessian crucibles are upon the whole the best. The black lead crucibles, made in England, are likewise excellent. They bear sudden heating and cooling well, and they are so soft that they can be conveniently cut with a knife, or saw any way that the experimenter pleases. Of late it is said that micaceous iron ore, or some similar ore of iron, has been substituted for black lead by the manufacturers. This is a grievous fraud, and injures the value of the crucibles most materially. Cast iron crucibles are sometimes used by chemists, but they are not of much value. Crucibles of fine silver are indispensible for the analysis of stony bodies, as silver best resists the action of alkaline bodies at high temperatures. Crucibles of platinum are also indispensible in a good laboratory. They bear almost any temperature, and are but little acted on by most chemical agents.

Mortars of various kinds, for pounding solid bodies, are also necessary for the laboratory. There should be one of glass, one of Wedgewood ware, and one of agate There should also be one of steel, consisting of a hollow cylinder fitted into a flat steel piece. A solid steel cylinder should be fitted by grinding into the hollow cylinder. The hard stone (ruby, for example,) is to be put by little at a time into this mortar, and, by a smart blow with a hammer upon the solid cylinder, it is easily reduced to small fragments. These are ground to an impalpable powder in the agate or flint mortar. The reader will find figures of different mortars, searces, and various other utensils, as files, &c. which we do not think it worth while to mention, in Lavoisier's *Elements of Chemistry*.

It may be worth while to say a few words about lutes, which are essential to the practical chemist. Flour, almond-meal, or linseed-meal, make a good enough lute for a common still. They are made into a paste, applied when moist, and allowed to dry. The fat lute answers well for luting retorts and receivers. It is made by beating together pipe-clay and linseed-oil. As it never becomes hard, it is requisite to cover it with linen, and tie the whole firm with a string. The best way is to dip the linen into a hot solution of glue, and to allow the linen to dry after it has been tied on, before beginning the distillation. For coating glass retorts, a mixture, of pipe-clay, sand, horse-dung and glue, made into a thin paste, answers well. The retort is dipped in, and after the first coating is dry, it is dipt again. This is continued till the coating is sufficiently thick for the purpose required. A very good lute for those joinings that are to be exposed to a strong heat is a mixture of clay and borax. We have also used successfully a mixture of clay, sand, and litharge. But this last lute is not so much to be depended on. Many other lutes are to be found in chemical books; but those we have mentioned are the ones which upon trial we have found best.† (c)

CHEMMIS. See ACHMIM.

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* For particulars relative to the proportions, &c. of the parts of different furnaces, the reader is referred to Henry's Chemistry. COXE.

† For this valuable article on CHEMISTRY, the Editor has been indebted to THOMAS THOMSON, M. D. F. R. S. London and Edinburgh.

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GENERAL EXPLANATION
OF THE
PLATES BELONGING TO VOLUME FIFTH
OF THE
AMERICAN EDITION
OF THE
NEW EDINBURGH ENCYCLOPÆDIA.

PLATE CV.

Fig. 1. Represents Buffon's large Burning Mirror, composed of 168 pieces of silvered glass.
Fig. 2, 3, 4. Shew the Machinery for adjusting each of the Mirrors.
Fig. 5. & 6. Represent another Burning Mirror, invented by Buffon, and consisting of a plate of flat silvered glass incurvated by the pressure of the atmosphere.
Fig. 7. & 8. Exhibit a third Burning Mirror invented by Buffon, in which the plane glass is incurvated by the pressure of the atmosphere, the vacuum being formed by the combustion of a sulphur match.
Fig. 9. & 10. Represent Peyrard's Burning Mirror, in which the solar rays are kept on the same spot by a particular adjustment.
Fig. 11. Exhibits Buffon's Burning Mirror with concentric zones.

PLATE CVI.

Fig. 1. Represents Parker's Burning Lens.
Fig. 2, 3, 4. Shew the method proposed by Dr Brewster of constructing Burning Lenses with solid segments.
Fig. 5. Represents the Catadioptric Burning Sphere, as proposed by Dr Brewster.
Fig. 6. & 7. Exhibit a portable Burning Pyramid proposed by Dr Brewster.

PLATE CVII.

Fig. 1. Represents the Machine for cutting Button Moulds.
Fig. 2, 3, 4, 5. Shew the old method of making Ornamental Buttons.
Fig. 6. Represents the Moulds for making Horn Buttons.
Fig. 7. Is the Pressing Vice for indenting the Horn into the exact pattern.
Fig. 8. Shews the Lathe for drilling Sailors Buttons.
Fig. 9. Is the Apparatus for drying off Gilt Buttons.

PLATE CVIII.

Fig. 1. Is the Common Mangle for smoothing cloth.
Fig. 2. & 3. Represent the Glazing Table.
Fig. 4. Is the Five Bowl Calender.
Fig. 5. Exhibits the Glazing Calender.
Fig. 6. Is the Water Press.
Fig. 7. Represents the Muslin Calender.

PLATE CIX.

Fig. 1, 2, 3. Represent the Camel which was chiefly used by the Dutch for lifting their vessels over shallows by the buoyant power of water.
Fig. 4, 5, 6. Shew the Camera Lucida for drawing in Perspective, invented by Dr Wollaston.
Fig. 7. Represents a new method of adapting the Camera Lucida to a Telescope, for taking Panoramic Views.

PLATE CX.

Contains various Figures illustrative of the phenomena and theory of Capillary Attraction.

PLATE CXI.

Fig. 1. Shews the form of the Cardwires, and the method of fixing them into the leather.
Fig. 2. Represents Mr Beard's Card-wire Machine.
Fig. 3. Shews the Dies for straightening the Wire.
Fig. 4. & 5. Represent an enlarged view of the Pliers for holding the Wire.

PLATES CXII. and CXIII.

These two Plates contain Diagrams for illustrating the theory of Carpentry.

PLATE CXIV.

Contains Diagrams illustrative of the geometrical principles of Carpentry.

PLATES CXV. CXVI. CXVII. CXVIII.

The Figures contained in these Plates are illustrative of the stereographical principles of Carpentry. See Carpentry.

PLATE CXIX.

The Diagrams in Plates CXIX. CXX. illustrate the subject of Groins.
Fig. 1. Is a Cylindrical Groin.
Fig. 2. Is a Cylindroido-cylindric Groin.

PLATE CXX.

Fig. 1, 2, 3, 4. Shew the plan of Gothic groining.
Fig. 7. Is an equilateral fan Groin.
Fig. 8. Is an oblong fan Groin.

PLATE CXXI.

Represents the method of Cylindro-cylindric Arching.

PLATE CXXII.

Contains Diagrams for illustrating the subject of Roofing.

PLATE CXXIII. CXXIV.

Illustrate the method of covering circular Roofs.

PLATE CXXV.

Fig. 1, 2, 3, 4, 5, 6, 7, 8. Represent the method of executing Niches with spherical Heads.

Fig. 9. Is the plan, section, and interior elevation of a pendentive Ceiling.

PLATE CXXVI.

Fig. 1, 2, 3, 4, 5, 6, 7, 8. Shew the method of scarfing Beams.

Fig. 9, 10. Illustrate the subject of naked Flooring.

PLATE CXXVII. CXXVIII.

Contain Diagrams for illustrating the subject of Truss Girders. See Carpentry.

PLATE CXXIX.

Fig. 1, 2, 3, 4. Represent different designs for Roofs.

Fig. 5, 6, 7, 8, 9. Illustrate the construction of Domes.

Fig. 10, 11, 12. Shew the method of forming the Centres for Bridges.

PLATE CXXX.

Fig. 1, 2, 3, 4, 5. Represent the Draw Loom for making Carpets.

Fig. 6, 7. Shew the new Automatic Carpet Draw Loom, invented by the author of the article Carpet.

PLATE CXXXI.

Represents a Carriage or Car taken from *The Triumph of Maximilian.*

PLATE CXXXII.

Exhibits a view of three modern Carriages.

PLATE CXXXIII.

Fig. 1. Represents the Bones of the Swimming Paw of the Dolphin.

Fig. 2. Is the Tail of the Piked Whale, shewn in Plate CXXXIV. Fig. 2.

Fig. 3. Shews the Skull, Jaws, and Teeth of the Dolphin.

Fig. 4. The form of the Teeth in the Physeter Tribe.

Fig. 5. Is the Tusk of the Narwhal.

Fig. 6. Shews the horny Plates of Whalebone in the Balænæ.

PLATE CXXXIV.

Fig. 1. Is the Black or Greenland Whale.

Fig. 2. The Piked Whale.

Fig. 3. The small-headed Narwhal.

Fig. 4. The blunt-headed Cachalot, or Spermaceti Whale.

Fig. 5. The Butskopf, or Beaked Whale.

PLATE CXXXV.

Fig. 1, 2, 3, 4, 5. Represent the Chaff Cutter invented by Mr R. Salmon of Woburn.

Fig. 6, 7, 8. Represent the Chaff Cutter with spiral Knives.

PLATE CXXXVI.

Fig. 1. Is a front elevation of the Tambouring Machine, invented by the author of the article Chainwork.

Fig. 2. Is a back elevation of the same.

Fig. 3. Is a profile elevation of the left hand part of the Machine.

Fig. 4. Shews the form of the traverse Wheels.

Fig. 5. Is a horizontal Section of the Tambour Machine immediately above the Needle Frame.

Fig. 6. Represents the Machinery for moving the Feeding and Working Needles.

PLATE CXXXVII.

Fig. 1, 2, 3, 4. Illustrate the construction of particular parts of the Tambouring Machine.

Fig. 5. Is the appearance of one of the Chains in Tambour Work.

Fig. 6. Is a profile elevation of a new Tambouring Machine invented by the author of the article Chainwork.

Fig. 7. Is a front view of the same.

Fig. 8—17. Illustrate the construction of particular parts of the Machine.

PLATE CXXXVIII.

Fig. 1. Is a profile elevation of the common Stocking Frame.

Fig. 5. Is a front elevation of the Rib Stocking Frame.

Fig. 10. Is a horizontal plan of the Needles in the Plated Stocking Frame.

Fig. 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14. Are illustrative of the different parts of these Machines.

PLATE CXXXIX.

Contains views of the different parts of a Machine for Weaving Fishing nets, invented by the author of the article Chainwork. See that article, p. 603.

PLATE CXL.

Fig. 1. & 2. Represent a Loom moved by power, for weaving Checks of every description, invented by the author of the article Check.

The rest of the Plate contains specimens of different Numeral Characters.

PLATE CXLI.

Fig. 1. Represents the differential Thermometer invented by Professor Leslie.

Fig. 2. Represents the Pyrometer contrived by Dr. Cromwell Mortimer, for determining the fusing points of the metals.

Fig. 3. Shews the Index and Circular Scale of the preceding Instrument.

Fig. 4, 5. Exhibit the Apparatus contrived and used by Dr Crawford for determining the specific heat of the Gases.

Fig. 6. Shews the contrivance for heating the Gases equally without moistening them.

Fig. 7. Represents the Calorimeter invented by Lavoisier and La Place, for determining the specific heat of bodies.

Fig. 8, 9, 10, represent a small tinned iron Water Trough, for preparing the gases, and containing the vessels in which the gases are confined. Fig. 9. is the Shelf, and Fig. 10. a Bottle Supporter.

Fig. 11, 12, 13, 14, 15, 16, and 17. are Retorts and Flasks with bent tubes, Receivers and Tubes for making experiments on Gases.

PLATE CXLII.

Fig. 1. A divided Glass Tube.

Fig. 2. Is a Gazometer for holding oxygen gas.

Fig. 3. and 4. represent another Gazometer of a different construction.

Fig. 5. Exhibits a Mercurial Trough for examining the properties of gases.

Fig. 6. Is a simple instrument, invented by Mr Cavendish, for conveying gases from one vessel to another.

Fig. 7. Represents a Balance for measuring the specific gravities of gases.

Fig. 8. Is a Detonating Apparatus contrived by Mr Pepys.

Fig. 9. Represents an ingenious apparatus, invented by Dr Henry of Manchester, for the Slow Combustion of Inflammable Gases.

Fig. 10. Is a Balloon Glass Receiver.

PLATE CXLII.—*No.* 2.

Fig. 1. A perspective view of a Furnace suitable for refining Camphor.

Fig. 2. A Flask used for refining Camphor.

Fig. 3. The same Flask in its separate iron sand-bath.

Fig. 4. Represents Mr William Hembel, jr's. method of mounting Woulfe's apparatus.

PLATE CXLIII.

Fig. 1. Is a Mattras with a wire for holding it by when hot.

Fig. 2. Is a Glass Funnel.

Fig. 3. Represents a Precipitating Vessel.

Fig. 4. Exhibits a Copper Still, fitted into a furnace, with a worm and refrigeratory.

Fig. 5. Shews a Glass Alembic for distillation.

Fig. 6. Exhibits a Woulfe's Apparatus fitted up for distillation.

Fig. 7. and 8. Represent a Perspective View and Section of Black's Portable Wind Furnace in its most improved form.

Fig. 9. Is a Muffle for exposing small vessels to the heat of a furnace.

Fig. 10, 11, 12, and 13. Represent a convenient and cheap Blast Furnace, invented by Mr Arthur Aikin.

Fig. 14, 15. Are Crucibles with their tops, the one triangular and the other circular.

Fig. 16, 17. Are Supports for Crucibles, the one being solid and the other hollow.

END OF VOLUME FIFTH.

W. Brown, Printer, Philadelphia.

BURNING INSTRUMENTS.

Fig. 5.

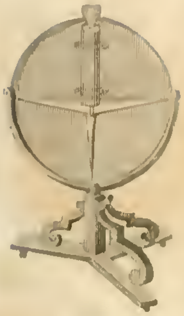


Fig. 1.

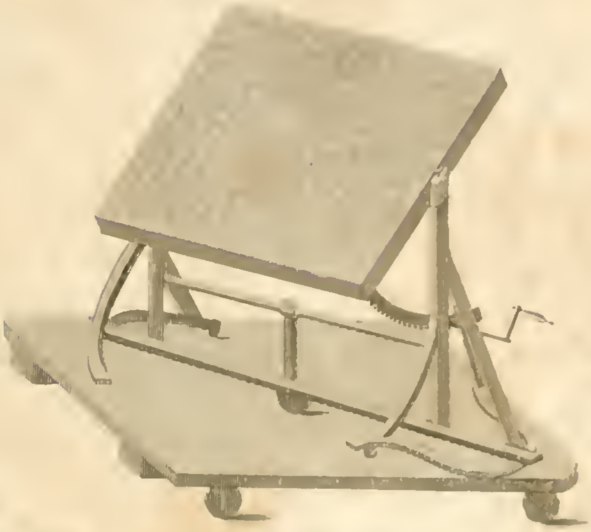


Fig. 7.

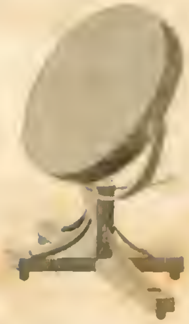
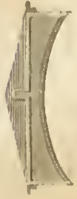


Fig. 6.



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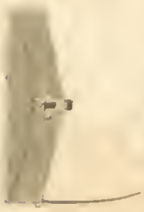


Fig. 2.

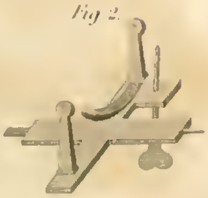


Fig. 3.

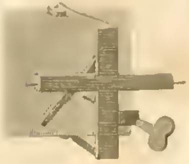


Fig. 4.

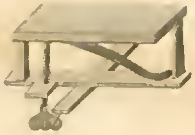


Fig. 9.

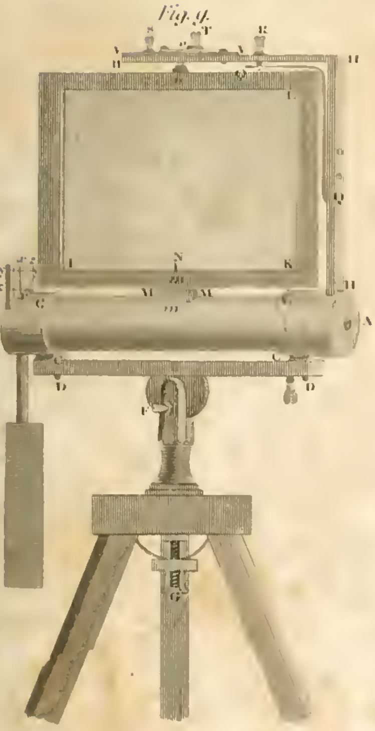


Fig. 10.

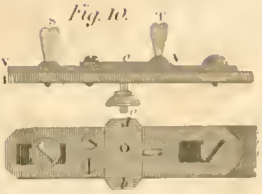
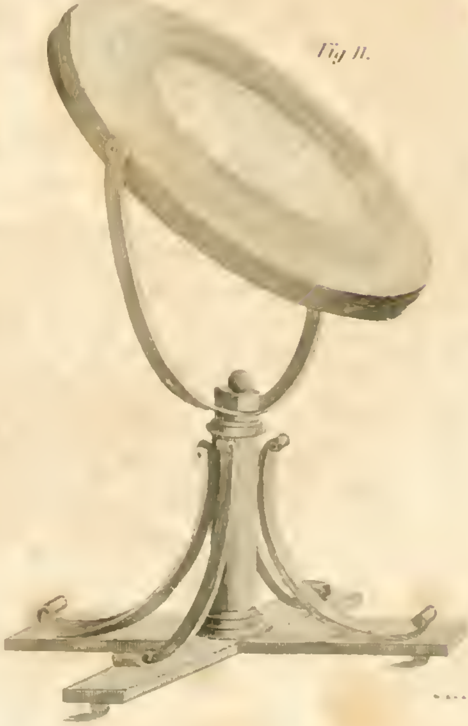


Fig. 11.



BURNING INSTRUMENTS.

PLATE CVI.

Fig. 1.

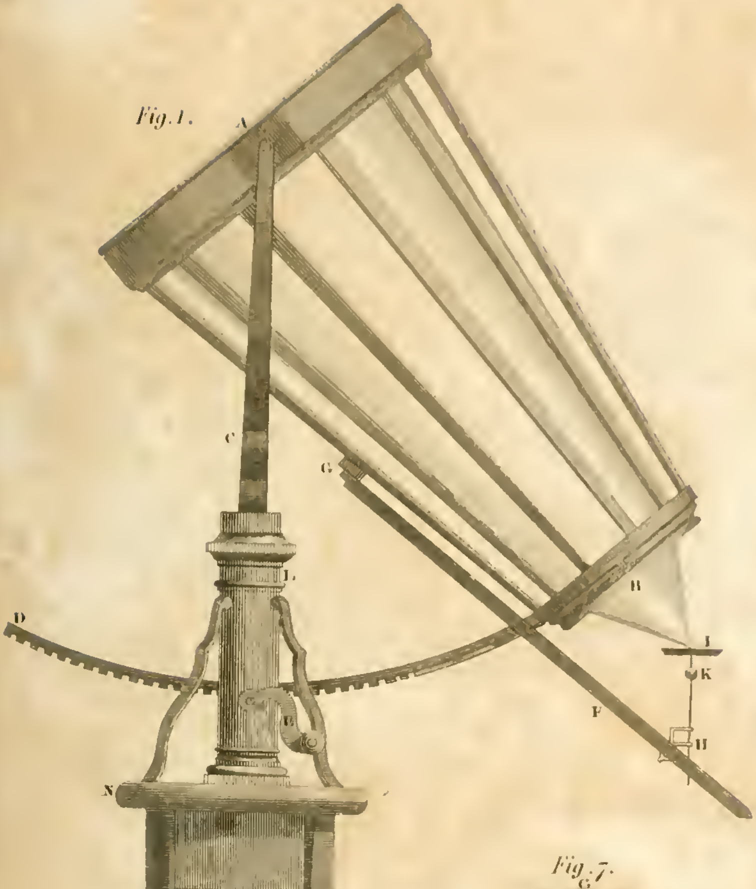


Fig 2

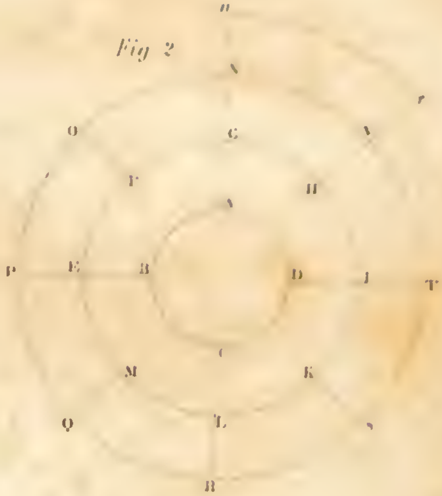


Fig 3.

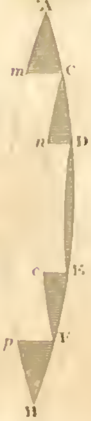


Fig. 4.

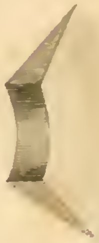


Fig. 7.

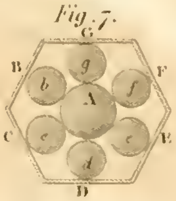


Fig. 5.

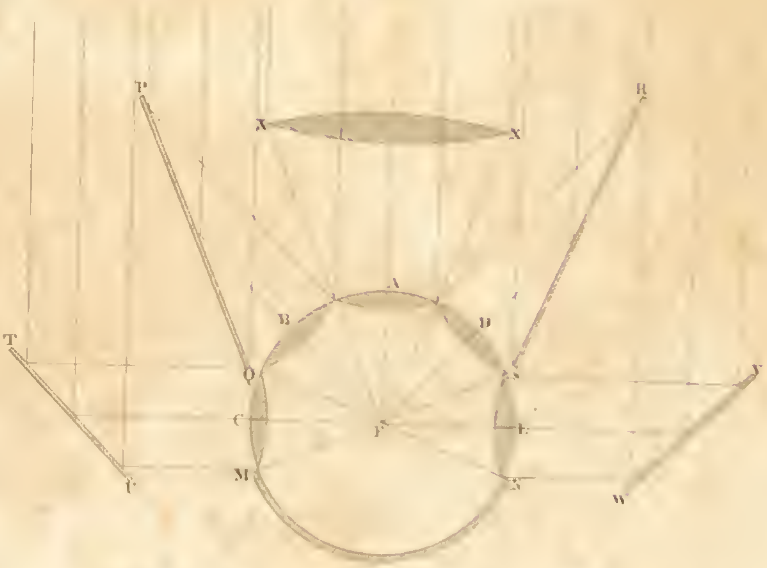
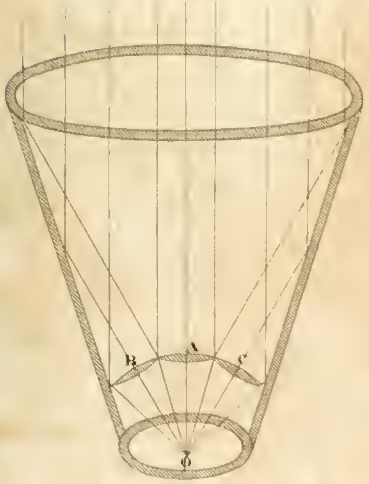
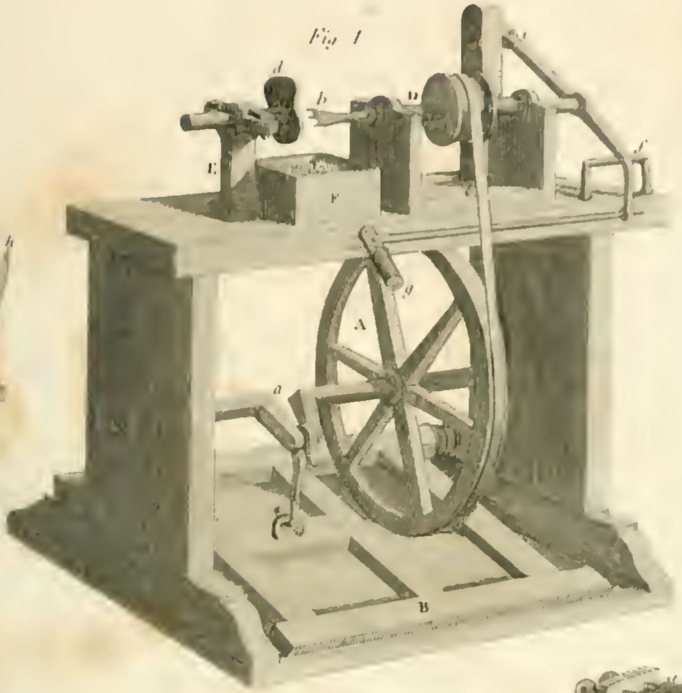


Fig. 6.



J.C. Sc.

Fig. 1.



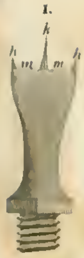


Fig. 2.

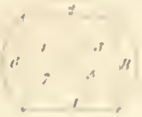


Fig. 3.

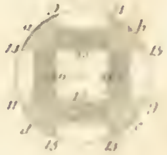
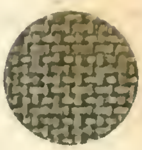


Fig. 4.

Fig. 5.



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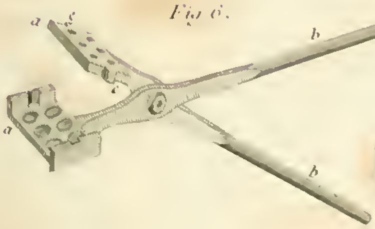

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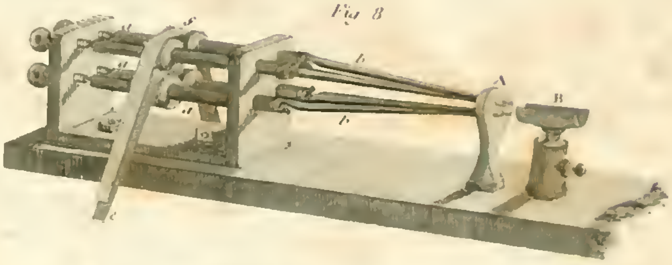


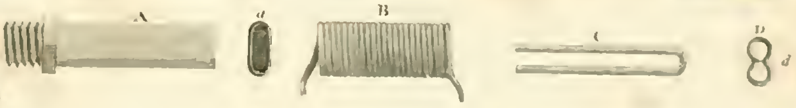
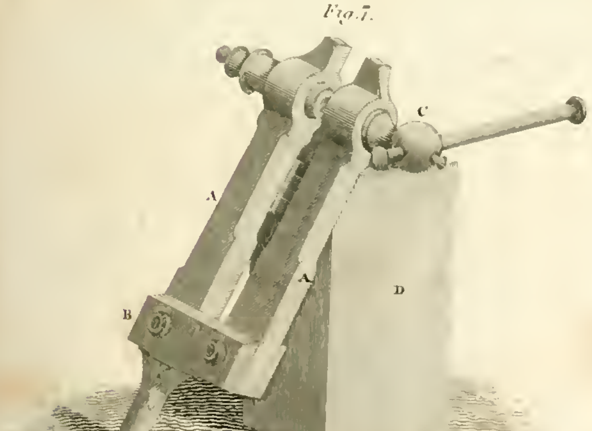


Fig. 7.



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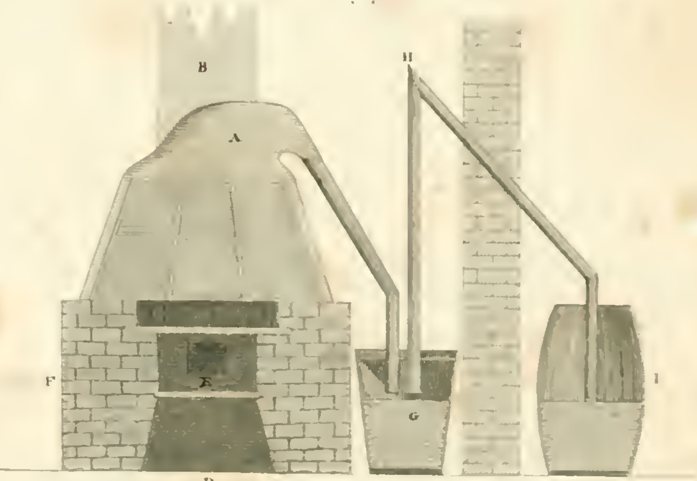
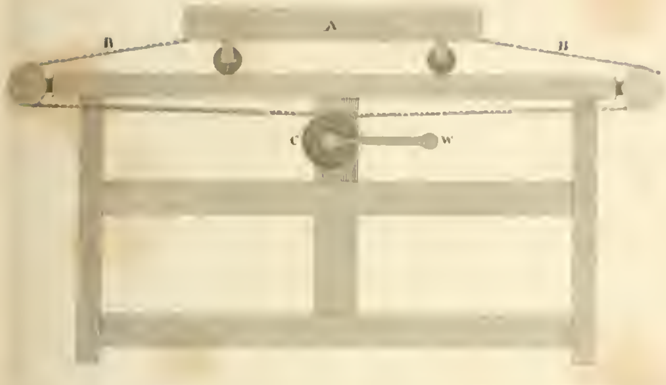


J. Farey delin.

H. Anamon

COMMON MANGLE.

Fig. 1



GLAZING TABLE

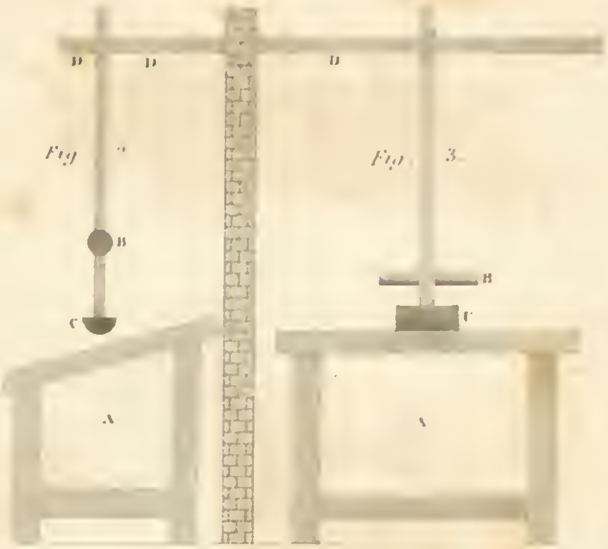
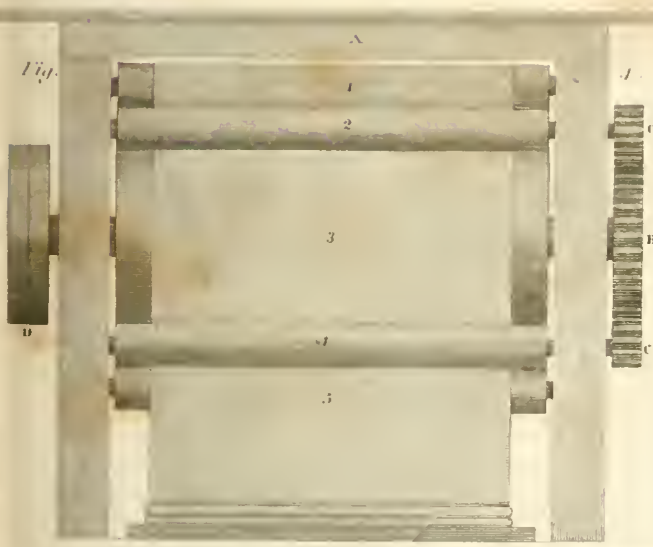
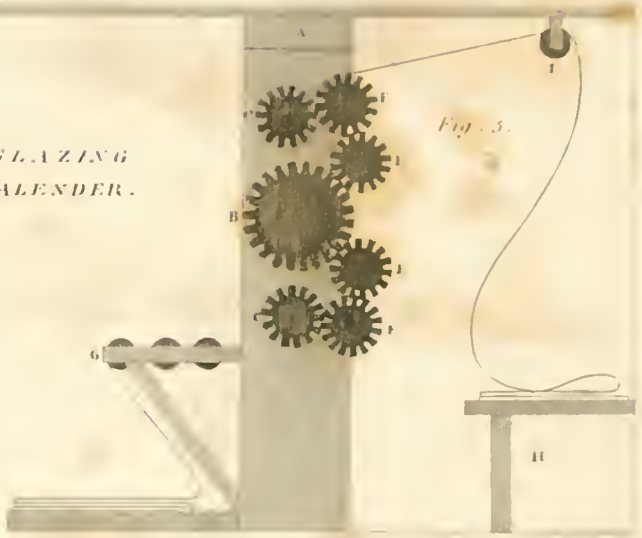


Fig.



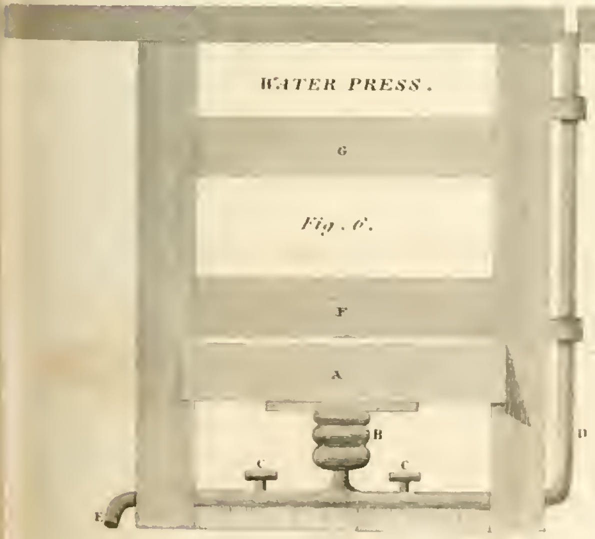
GLAZING CALENDER.

Fig. 5.



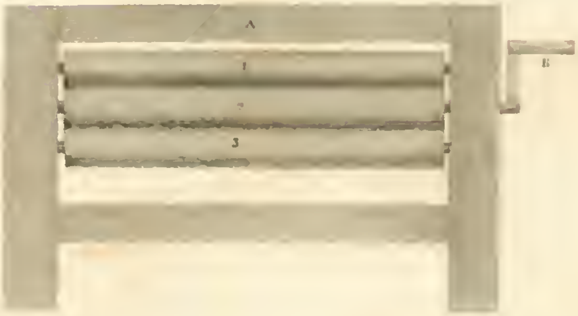
WATER PRESS.

Fig. 6.



MUSLIN CALENDER

Fig. 7



CAMEL. CAMERA LUCIDA. CANDLE.

PLATE CIX.

Fig. 1.

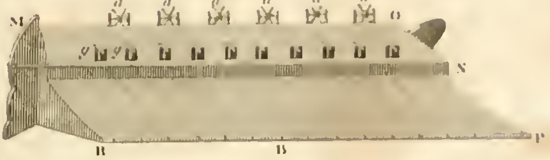


Fig. 2

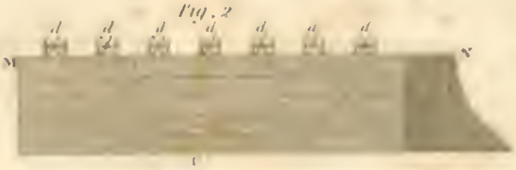


Fig. 4

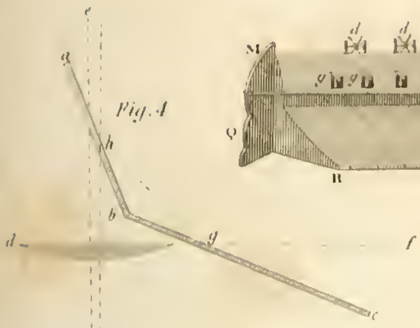


Fig. 3

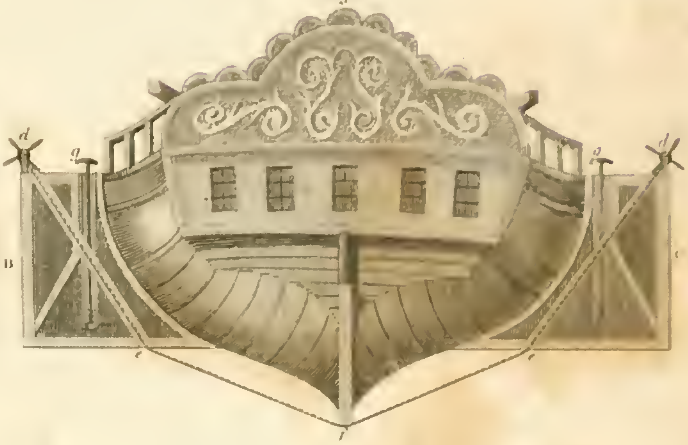


Fig. 5

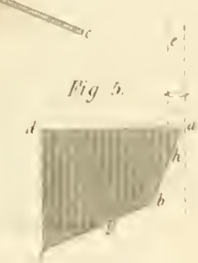
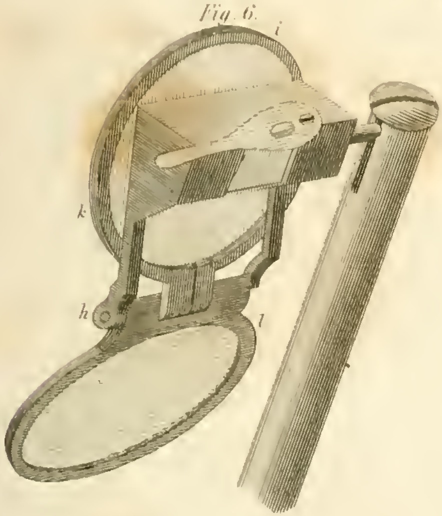


Fig. 6.



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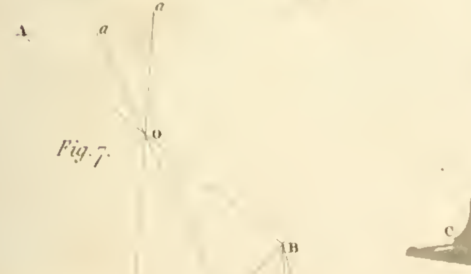

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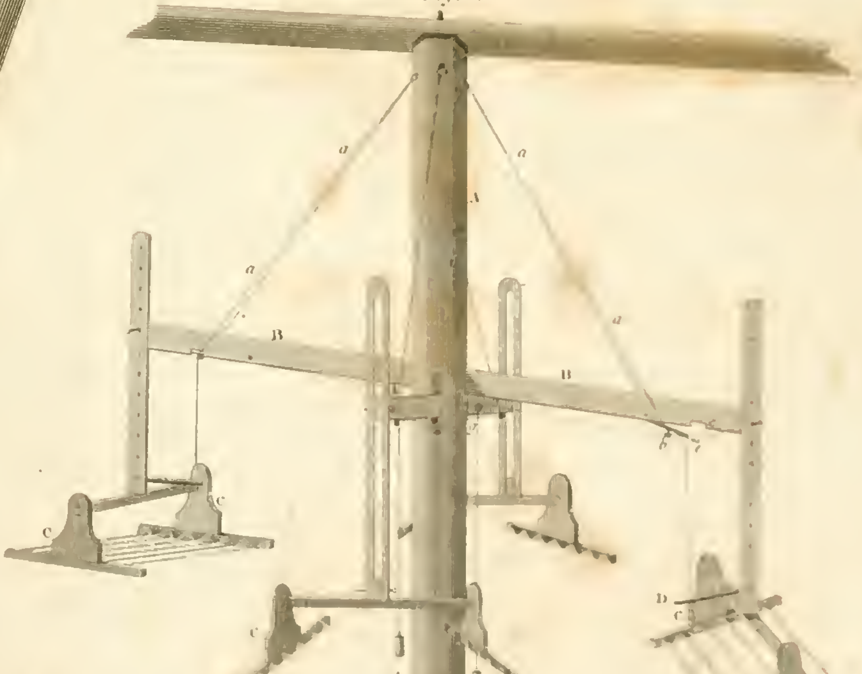
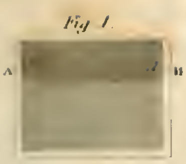


CAPILLARY ATTRACTION.

PLATE CV.

Fig. 1.



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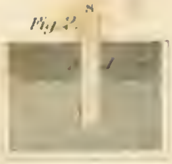
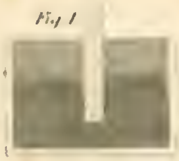


Fig. 3.

Fig. 4.



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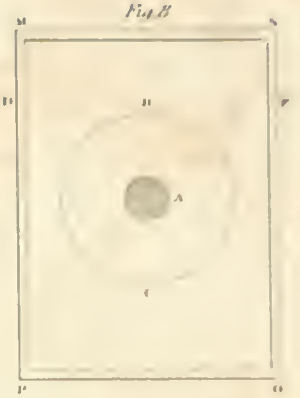

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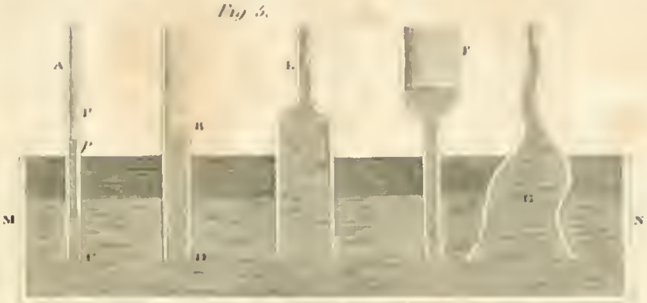

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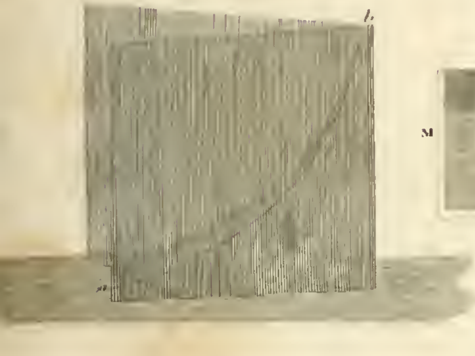

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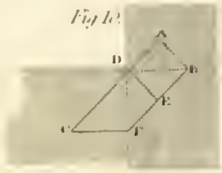

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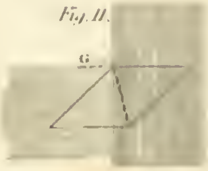

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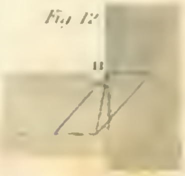

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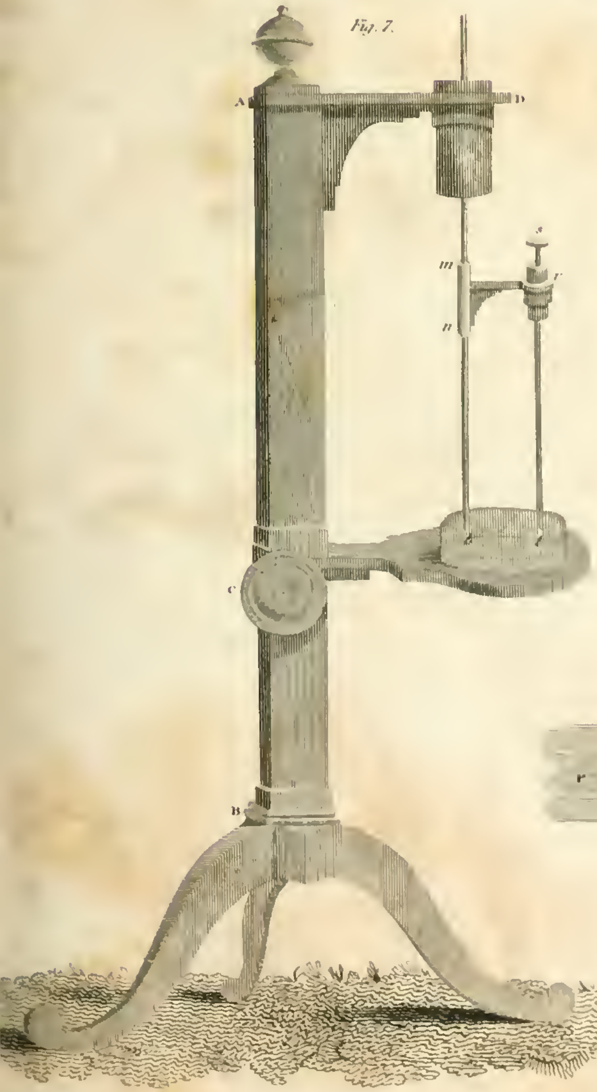

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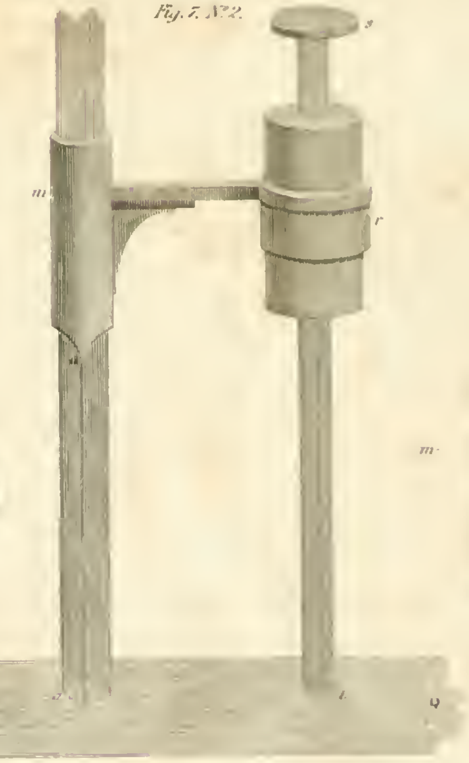

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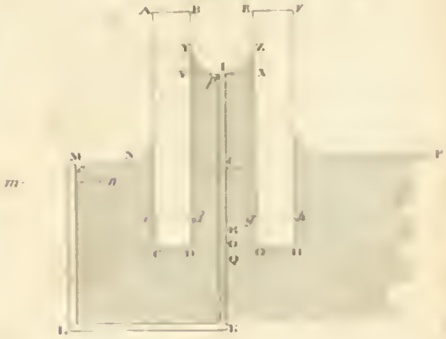


CARD WIRE MACHINE.

PLATE CVI.

Fig 2 Plan

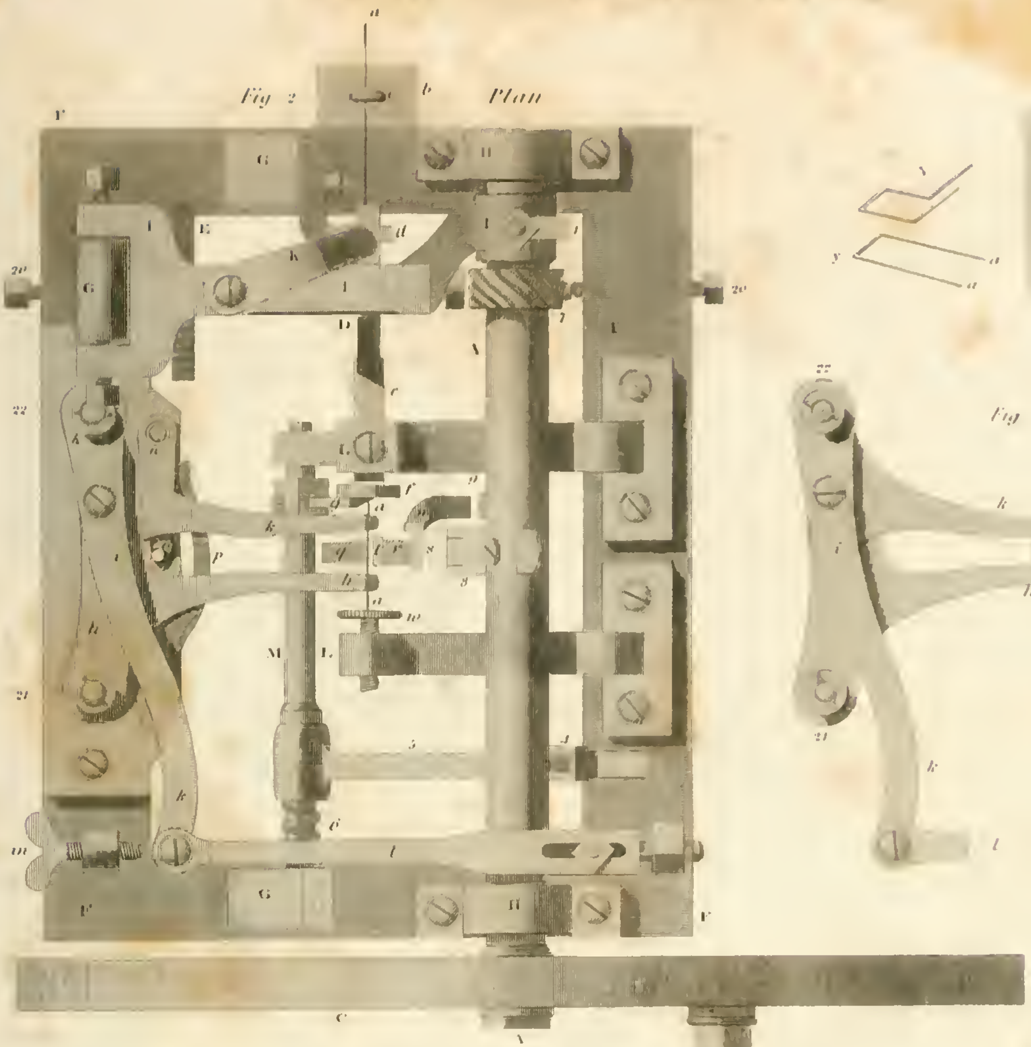
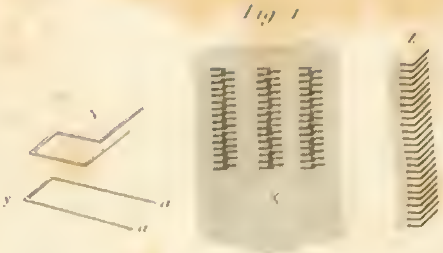


Fig 1



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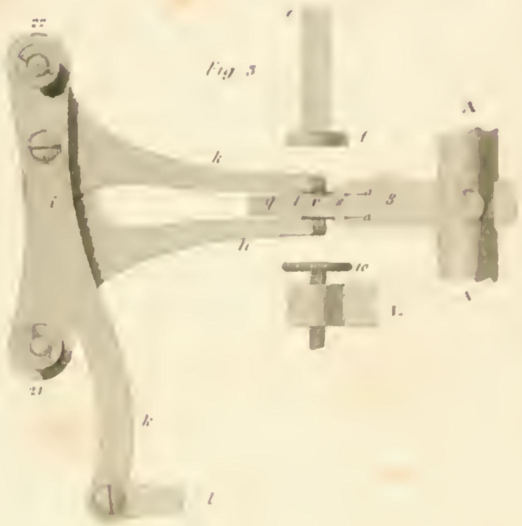

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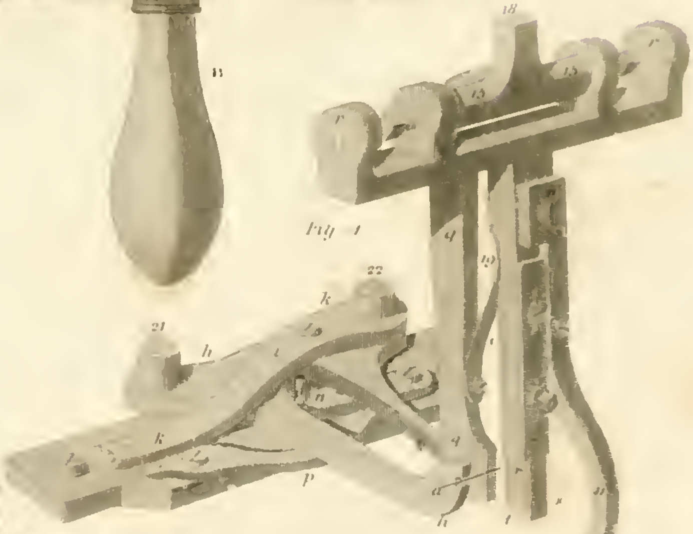


Fig 5
Section

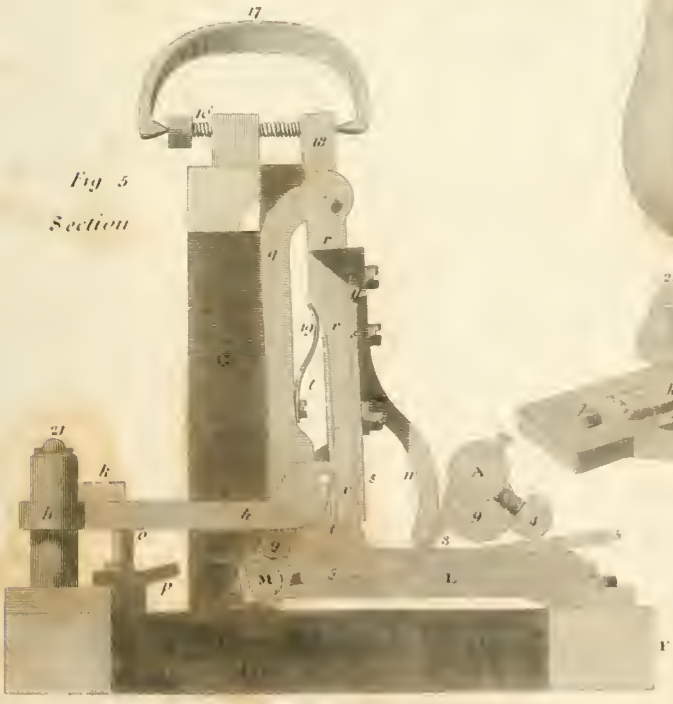
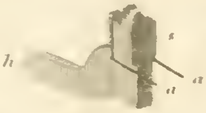


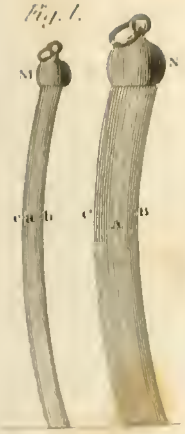
Fig 7



CARPENTRY.

PLATE CXII.

Fig. 1.



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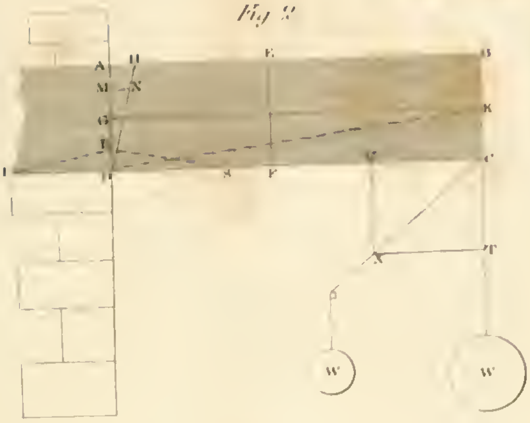
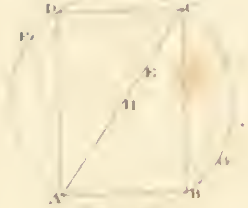


Fig. 3.

Fig. 5.



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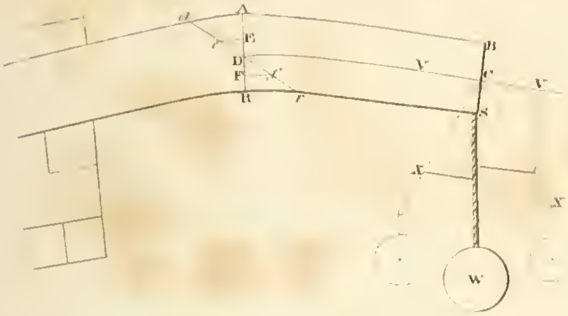

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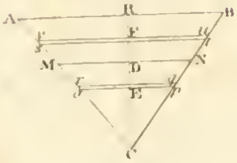

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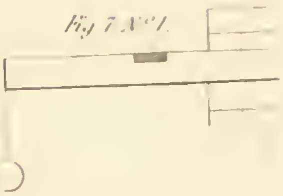

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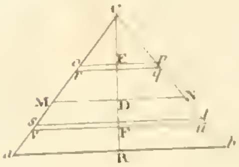

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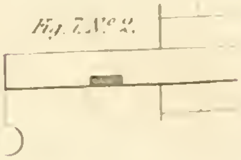

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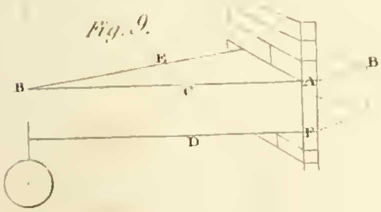

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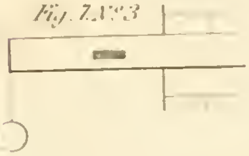

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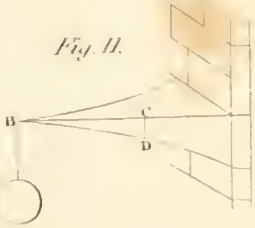

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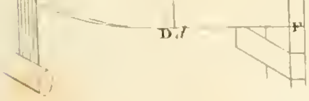

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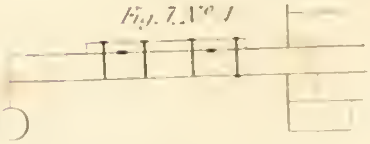

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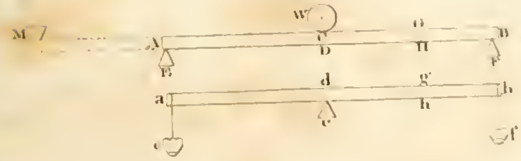

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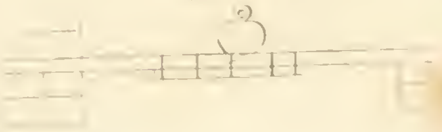

CARPENTRY. PLATE CXIII.

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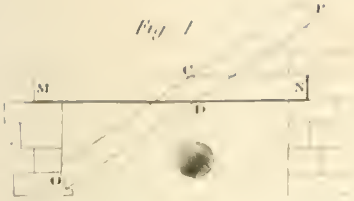

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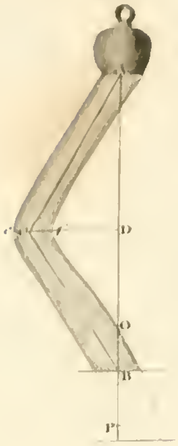

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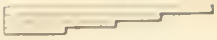

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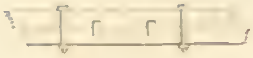

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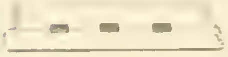

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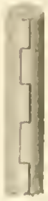
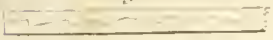


Fig. 8.



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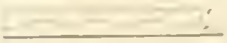

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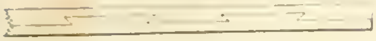

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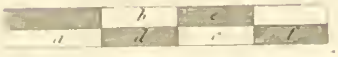

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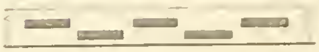

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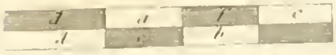

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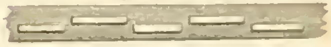

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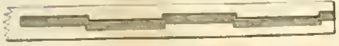

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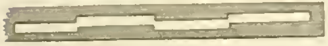

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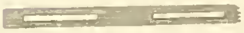

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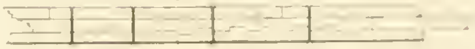

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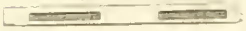

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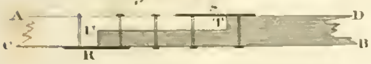

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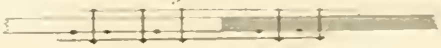

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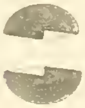

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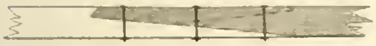

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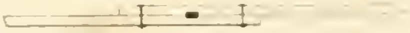

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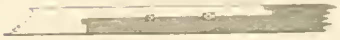

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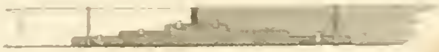

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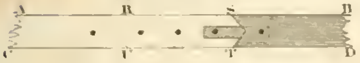

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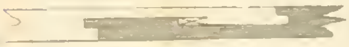


CARPENTRY.

PLATE CXIV.

GEOMETRICAL PRINCIPLES

Fig 1

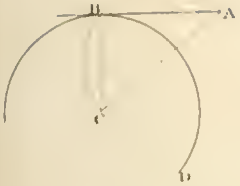


Fig 7

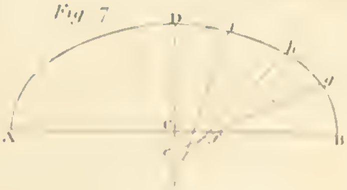


Fig 4

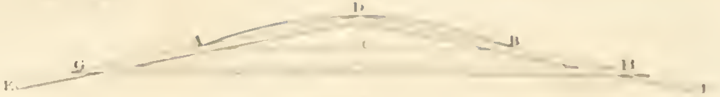


Fig 5

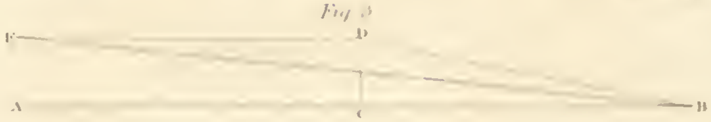
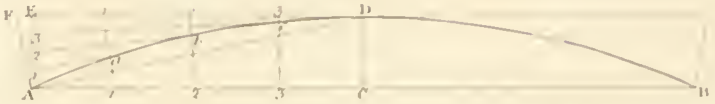


Fig 6



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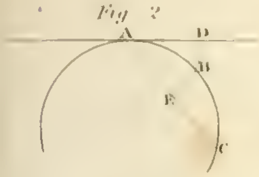
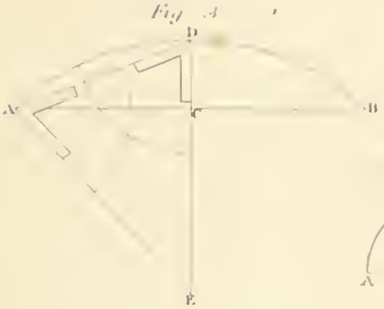


Fig 3



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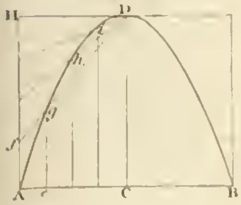


Fig 8

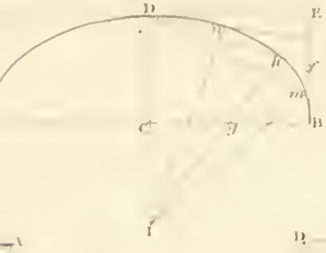
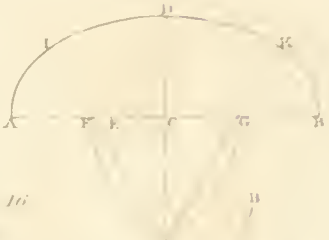


Fig 9



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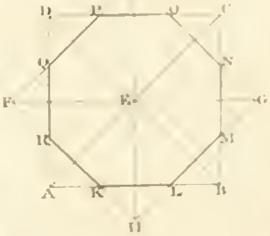

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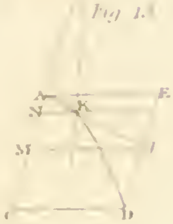

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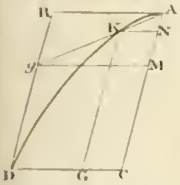

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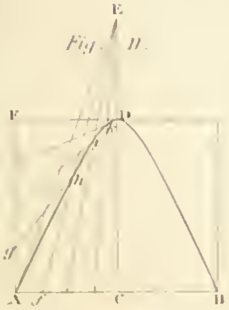

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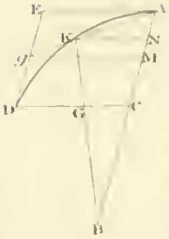

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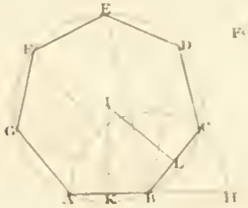

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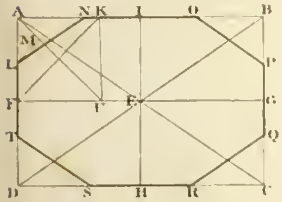

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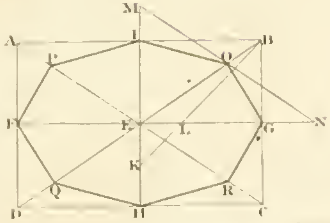

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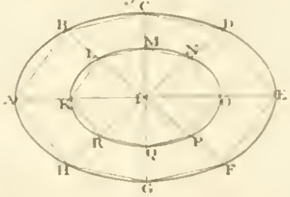

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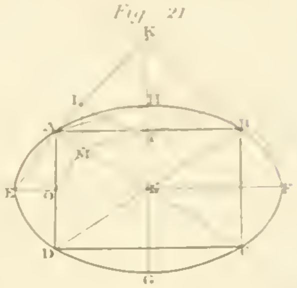

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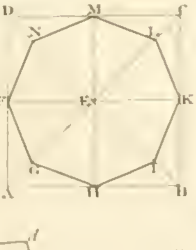

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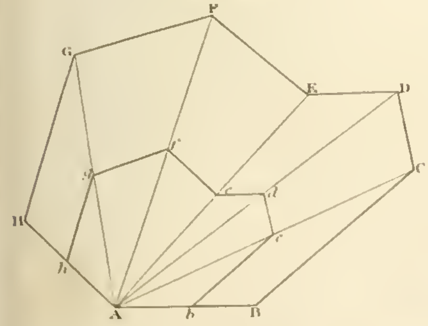

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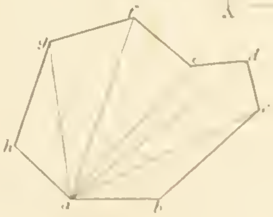

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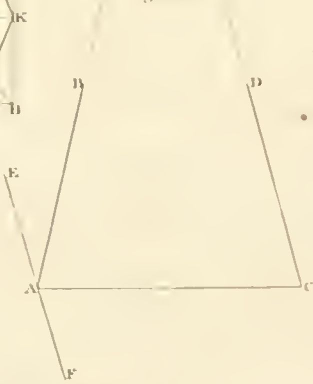

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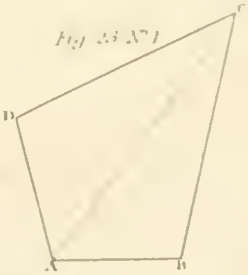

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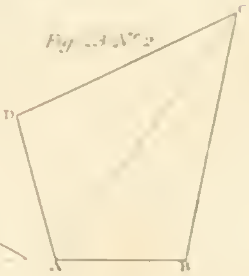

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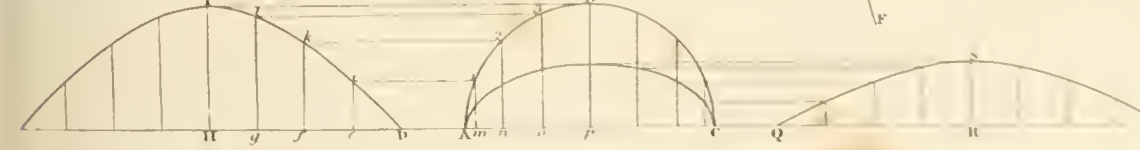

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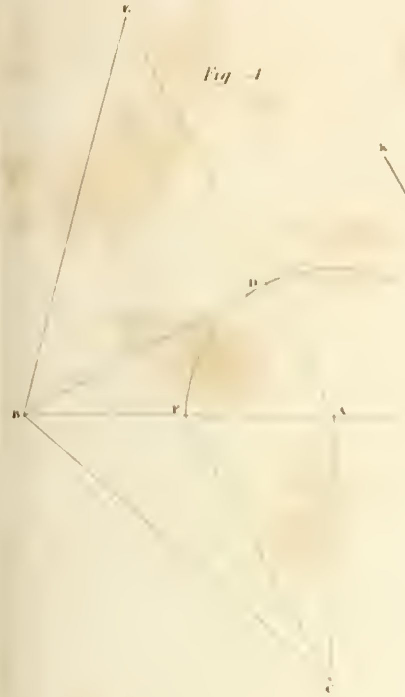

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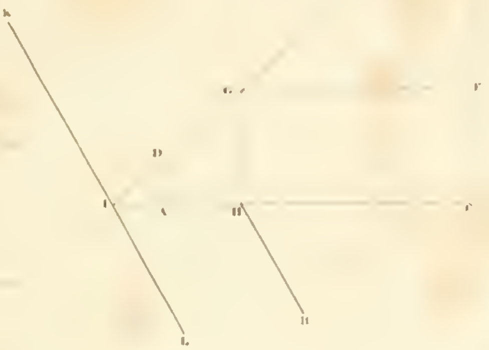

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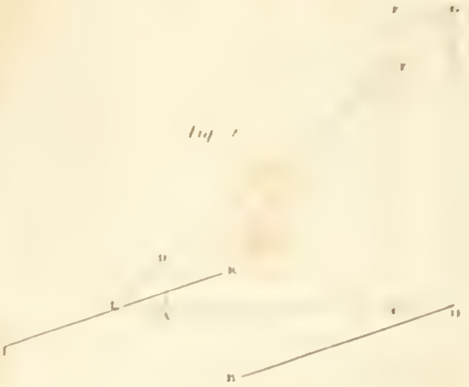

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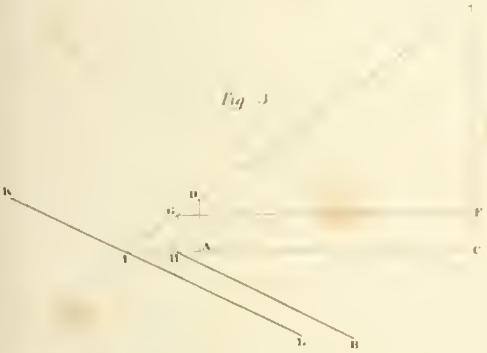

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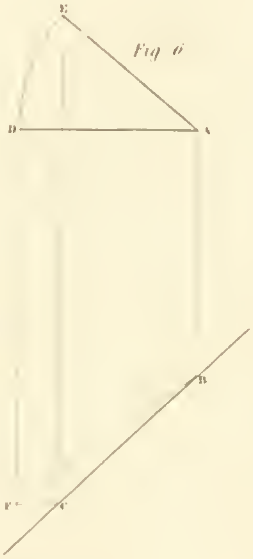

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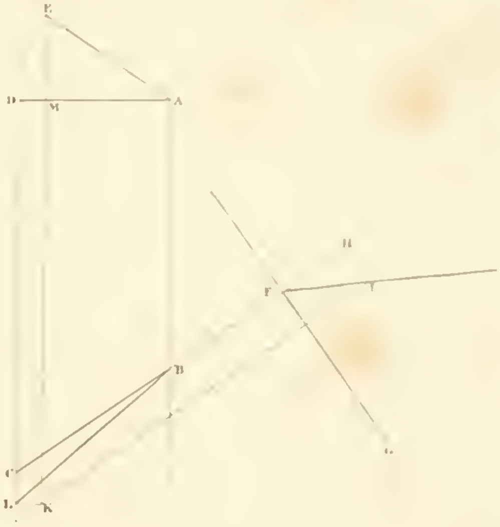

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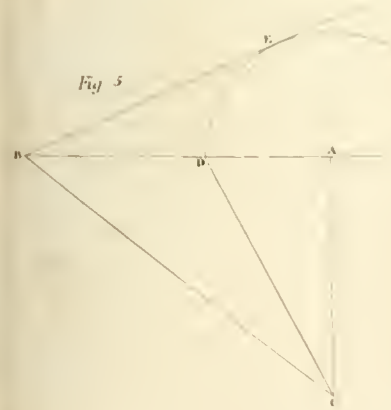

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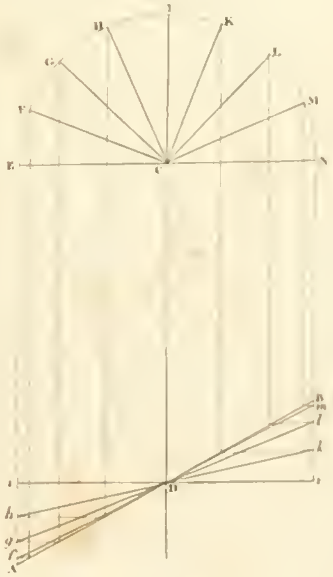

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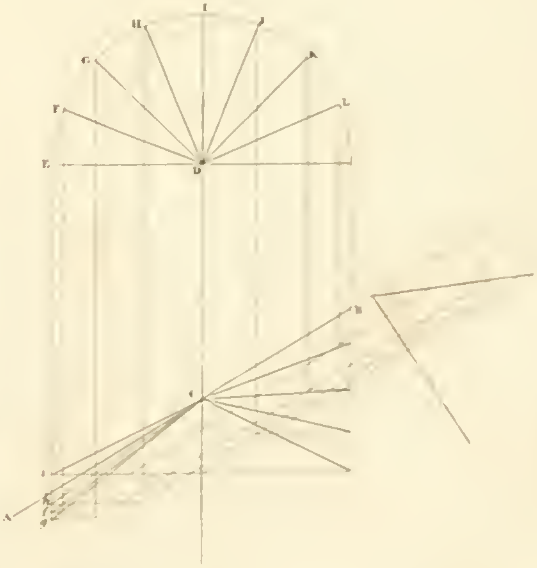

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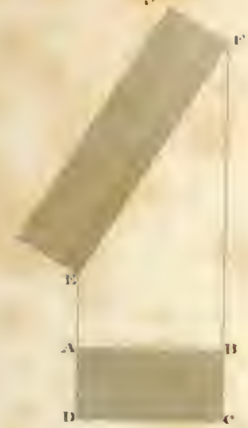

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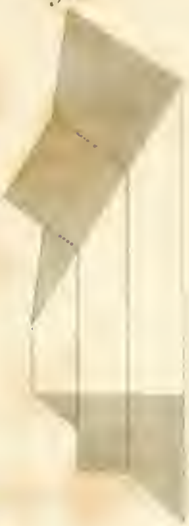

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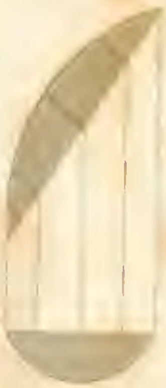

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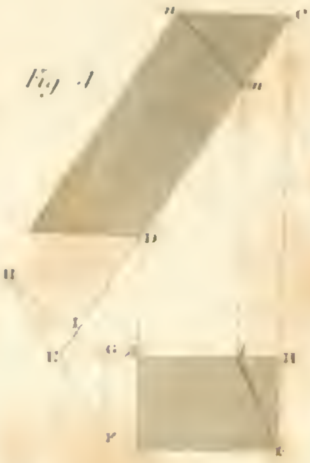

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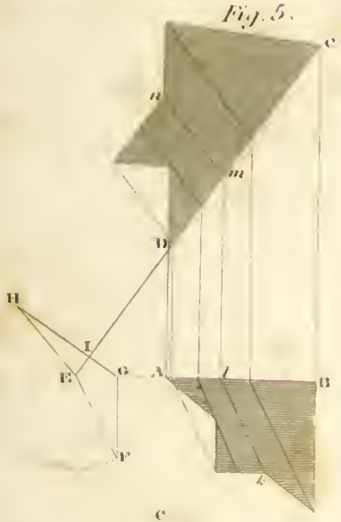

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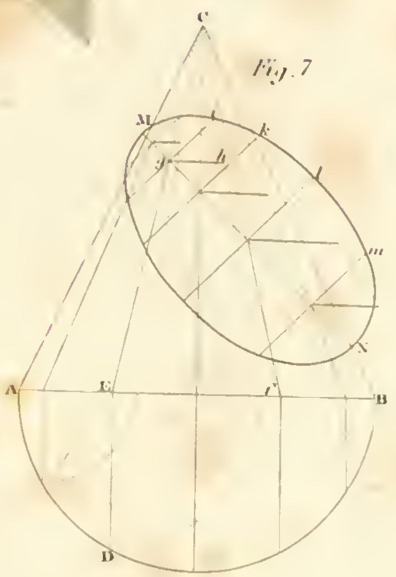

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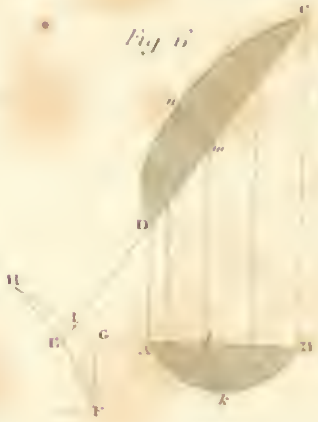

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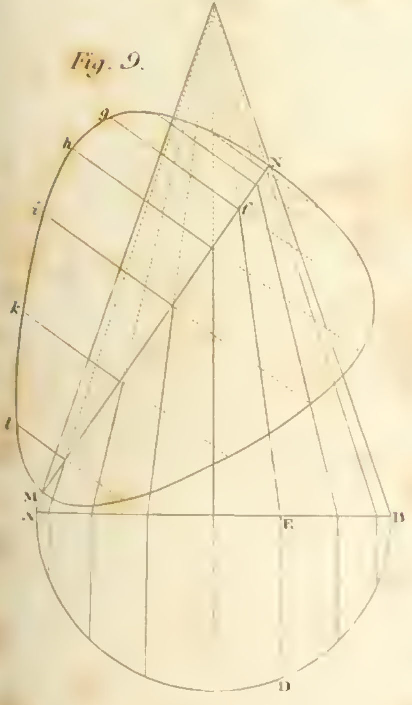

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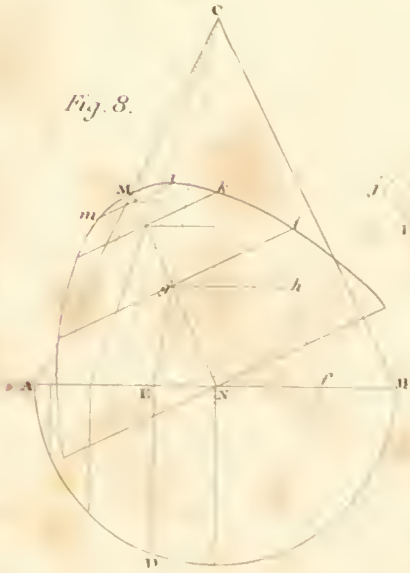

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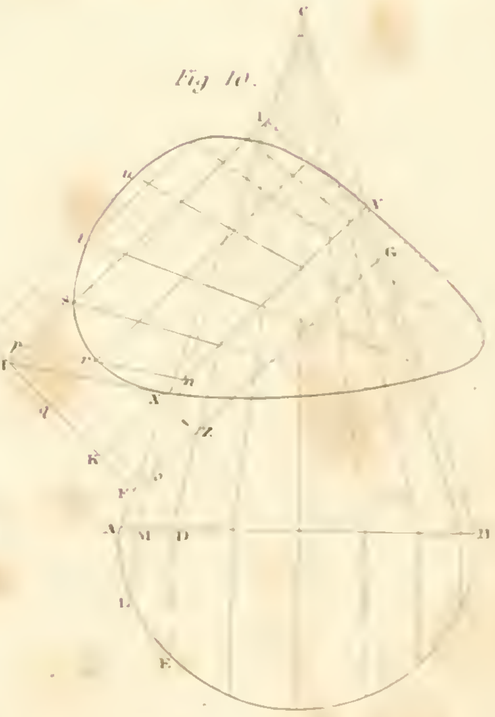

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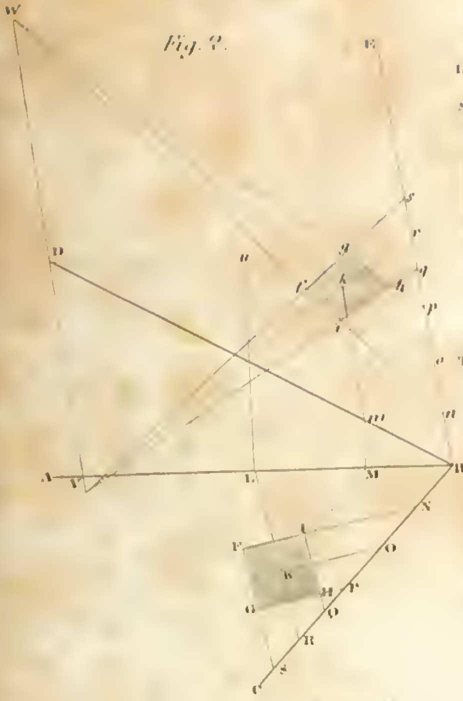

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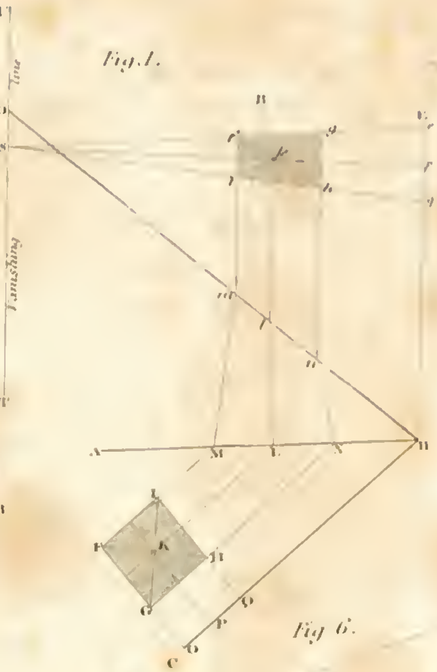

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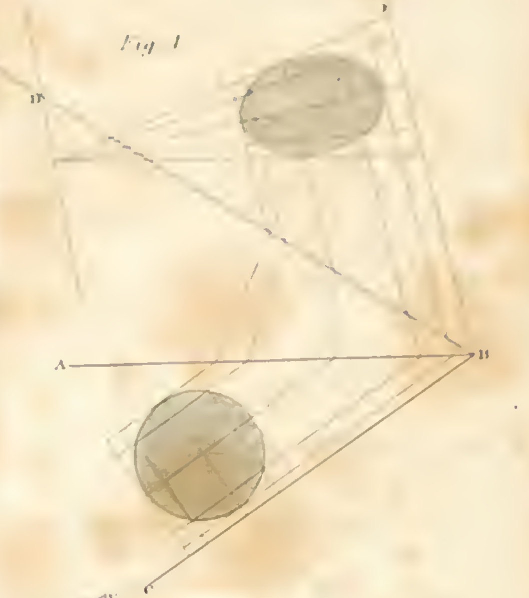

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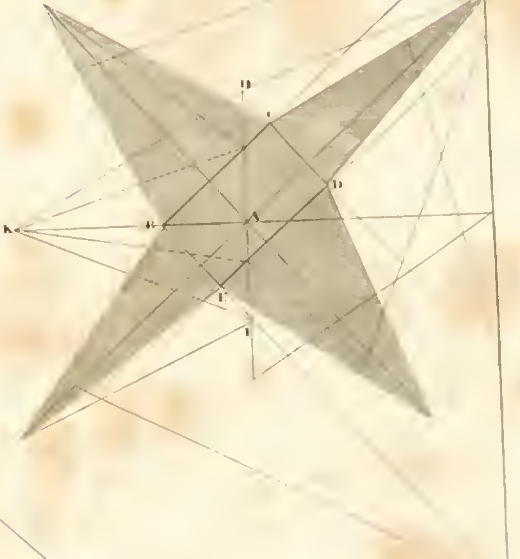

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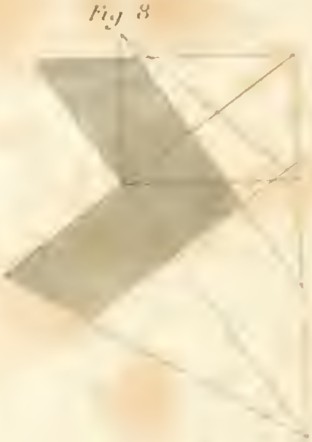

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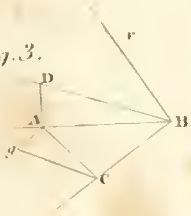

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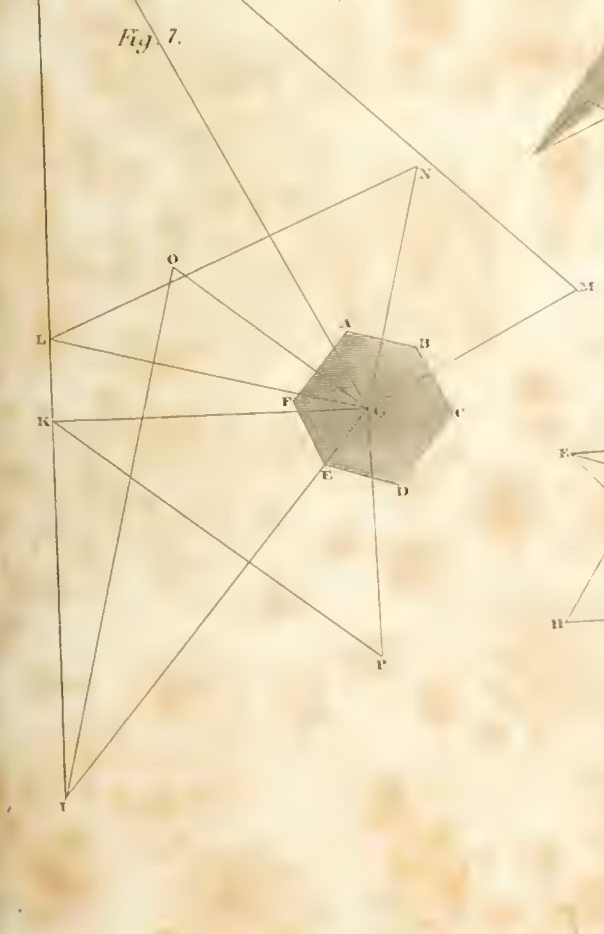

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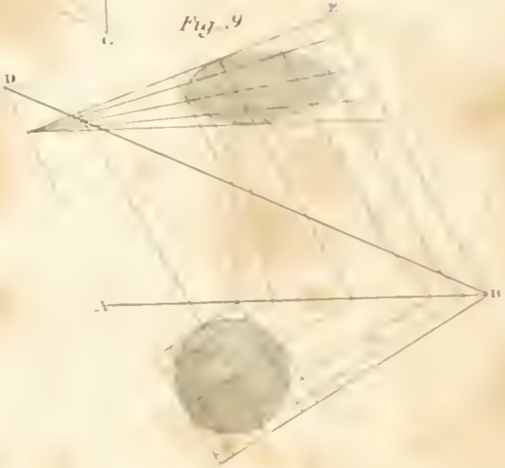

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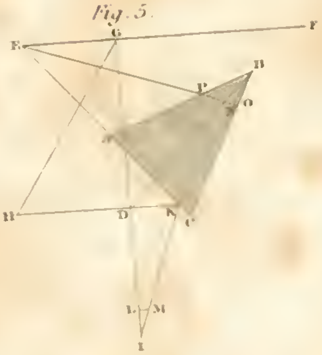

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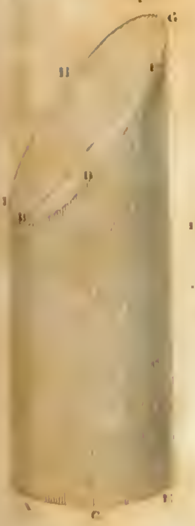

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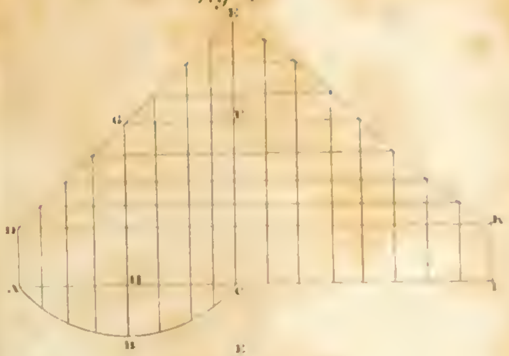

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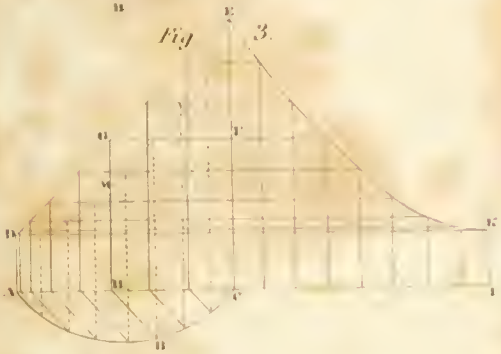

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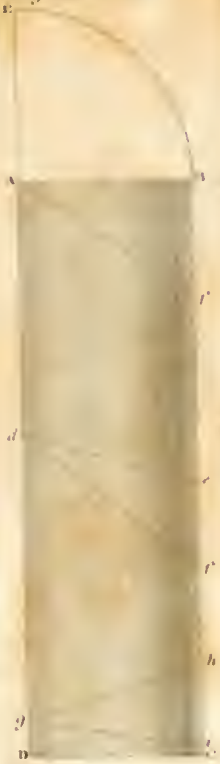

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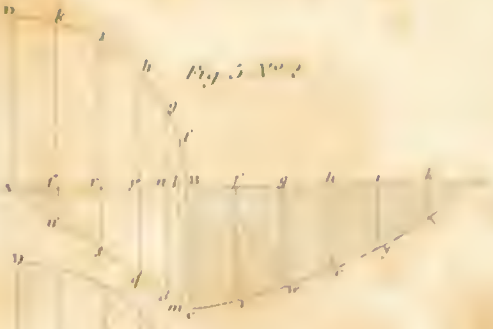

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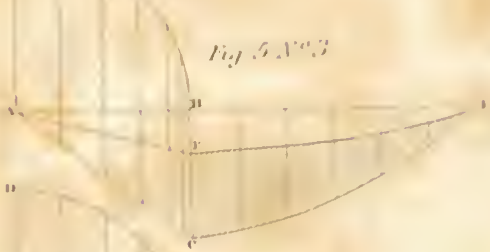

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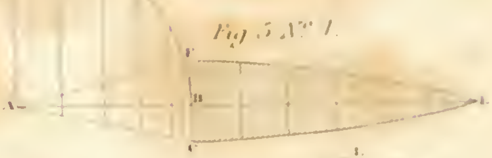

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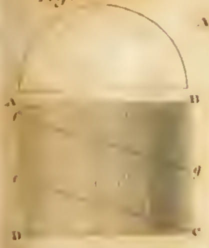

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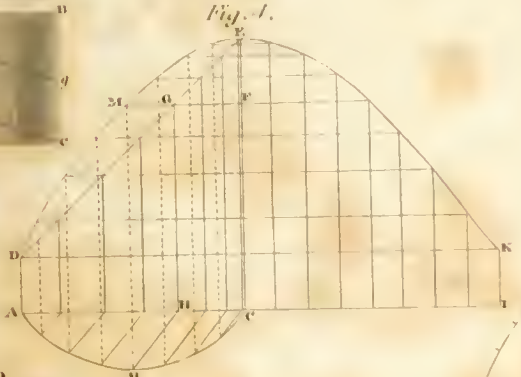

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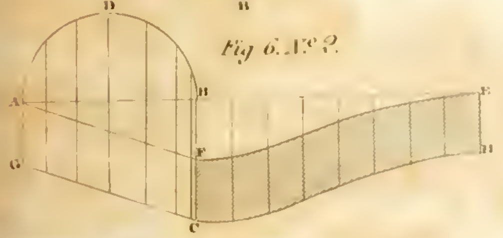

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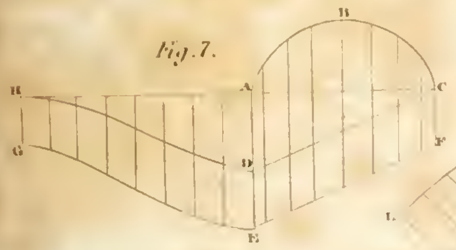

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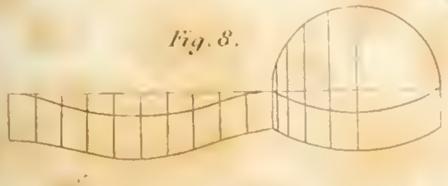

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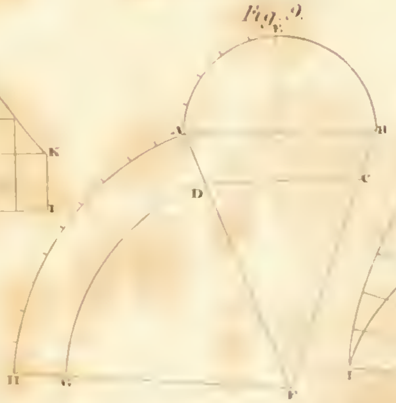

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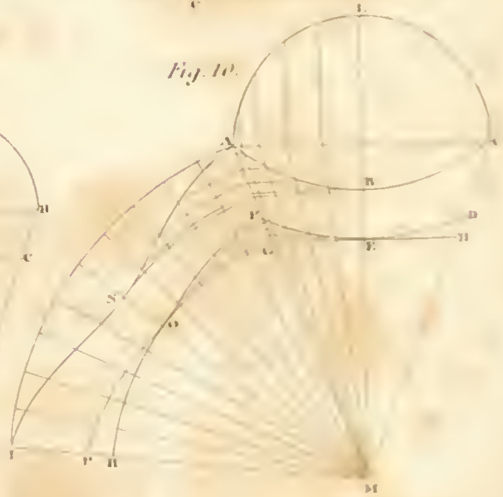

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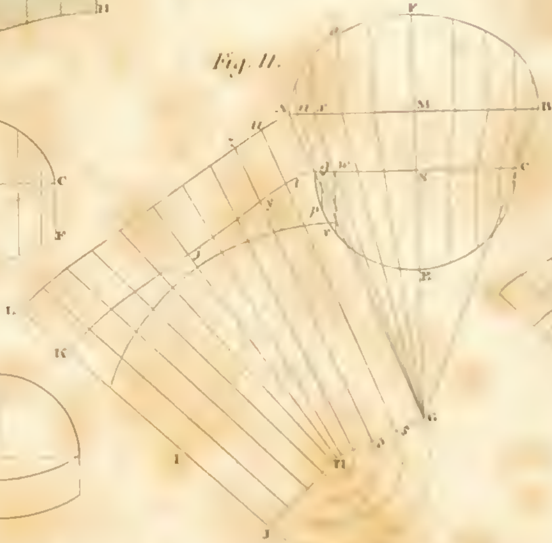

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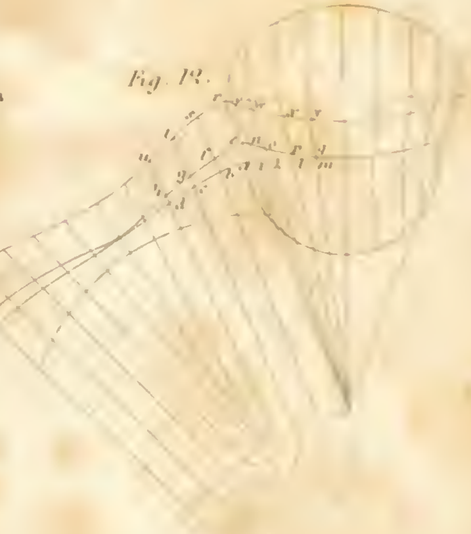

CARPENTRY. PLATE CXIX.

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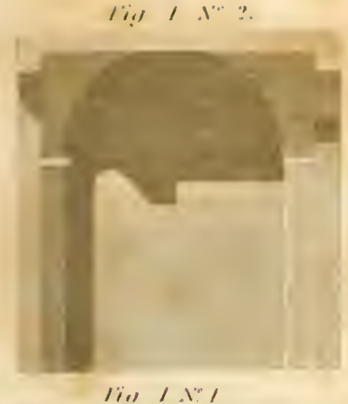

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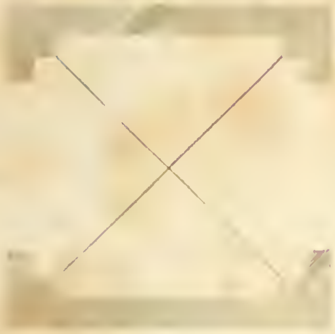

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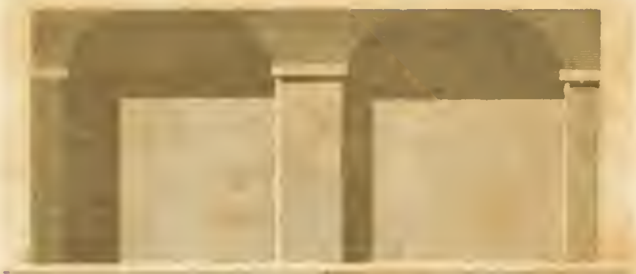

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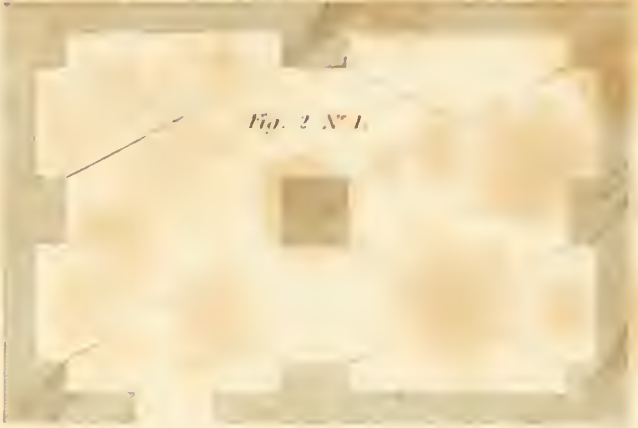

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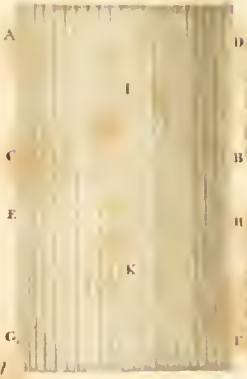

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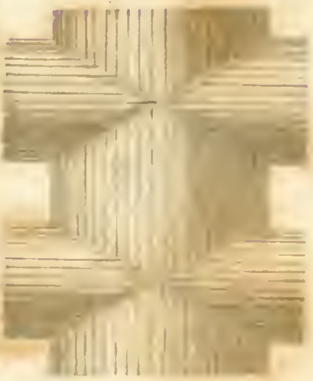

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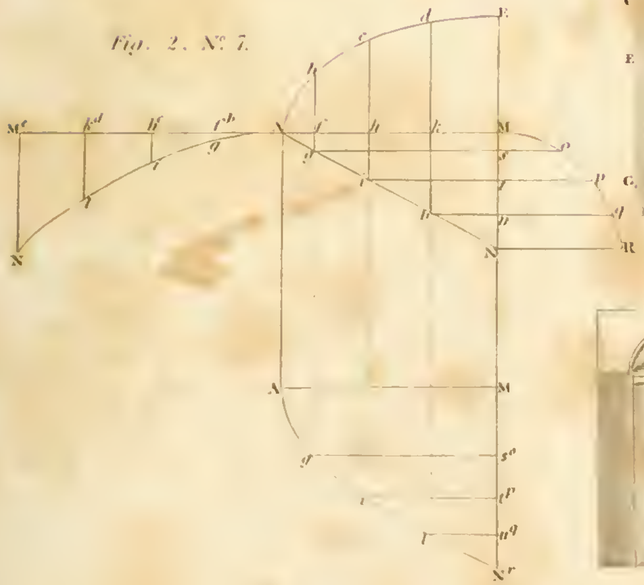

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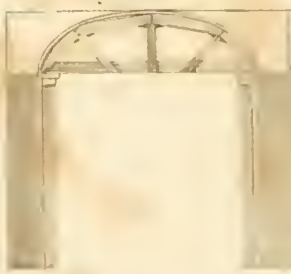

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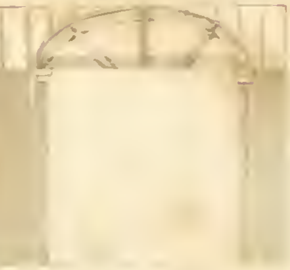

W. Charles fc.

CARPENTRY. PLATE CXX.

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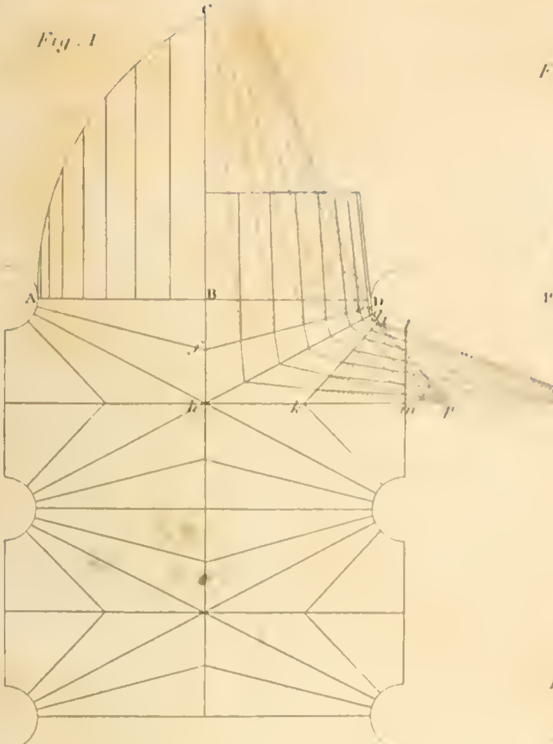
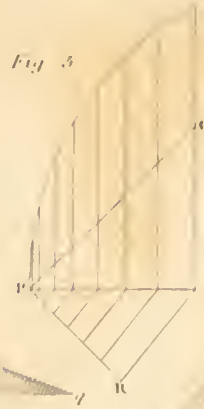


Fig. 5.



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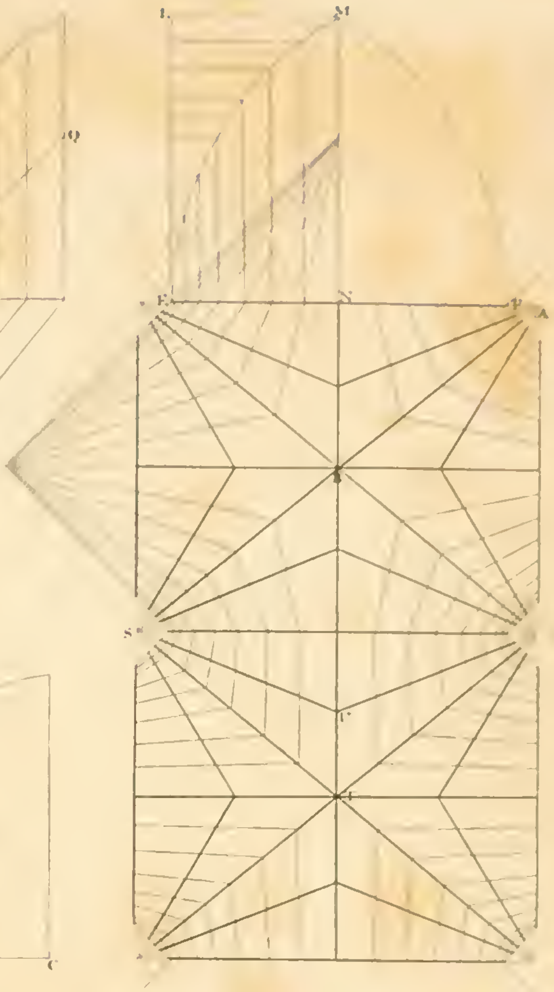

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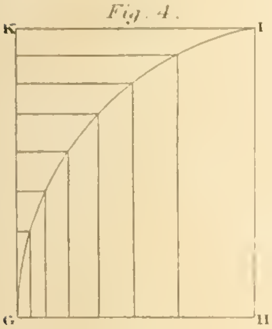

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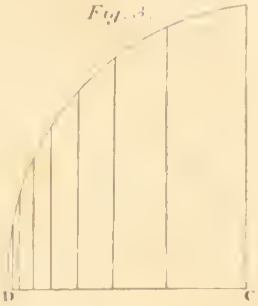

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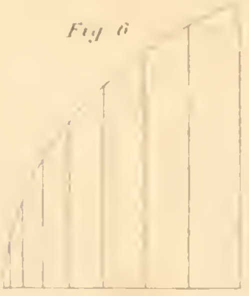

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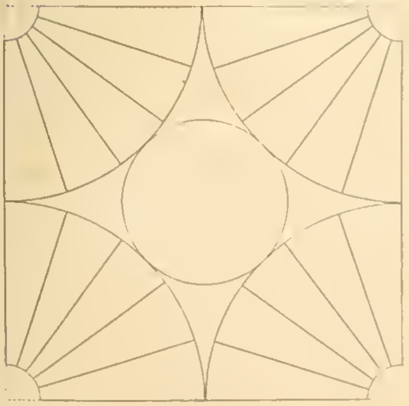

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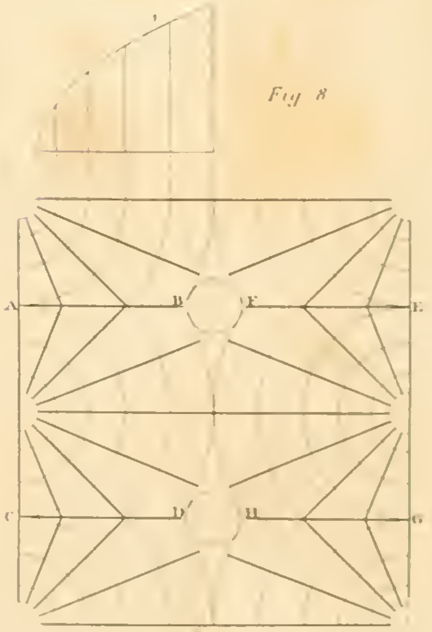

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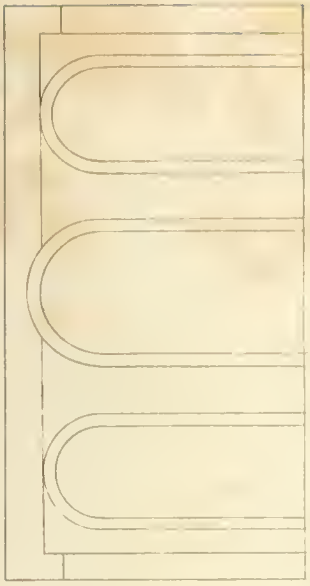

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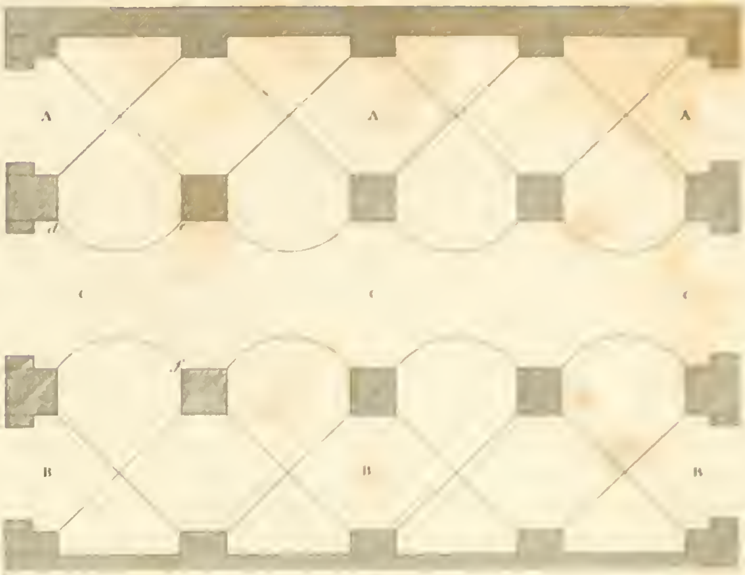
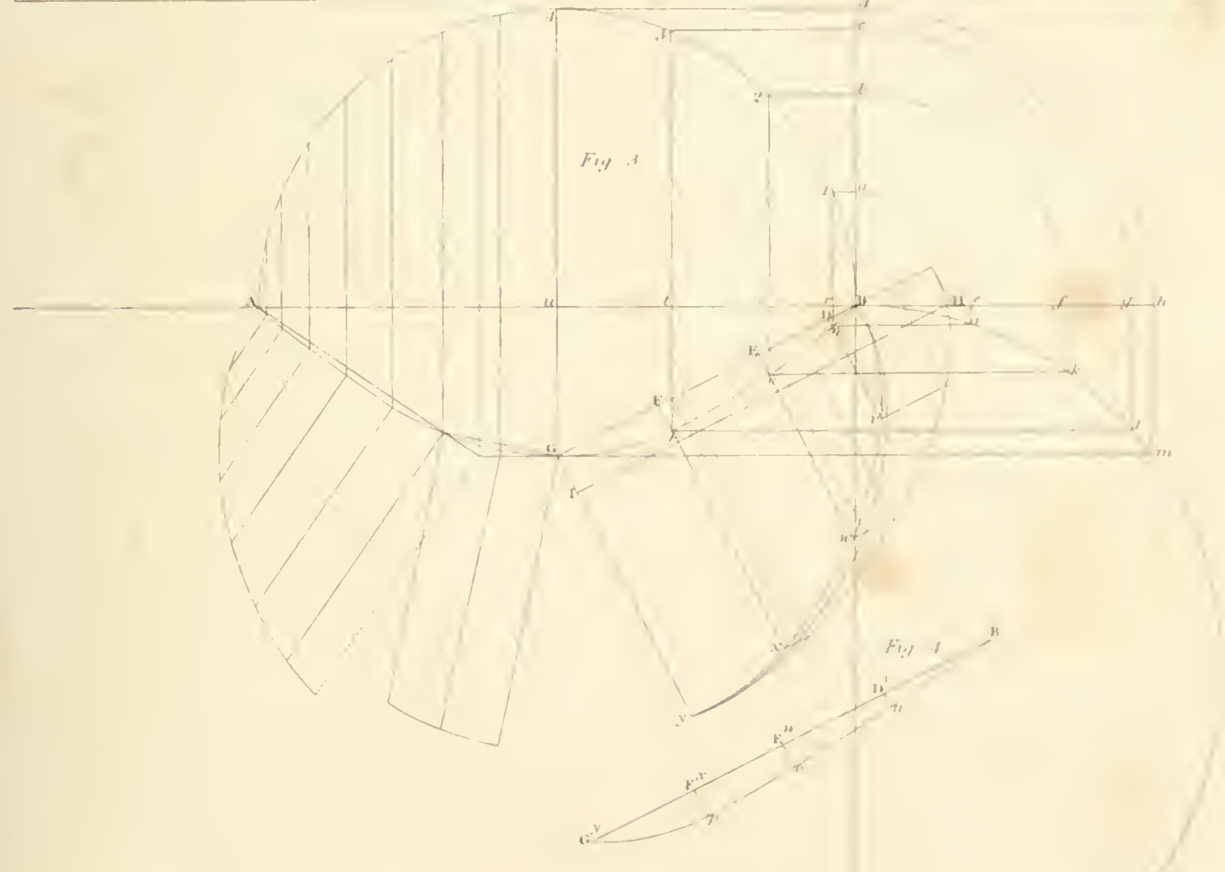
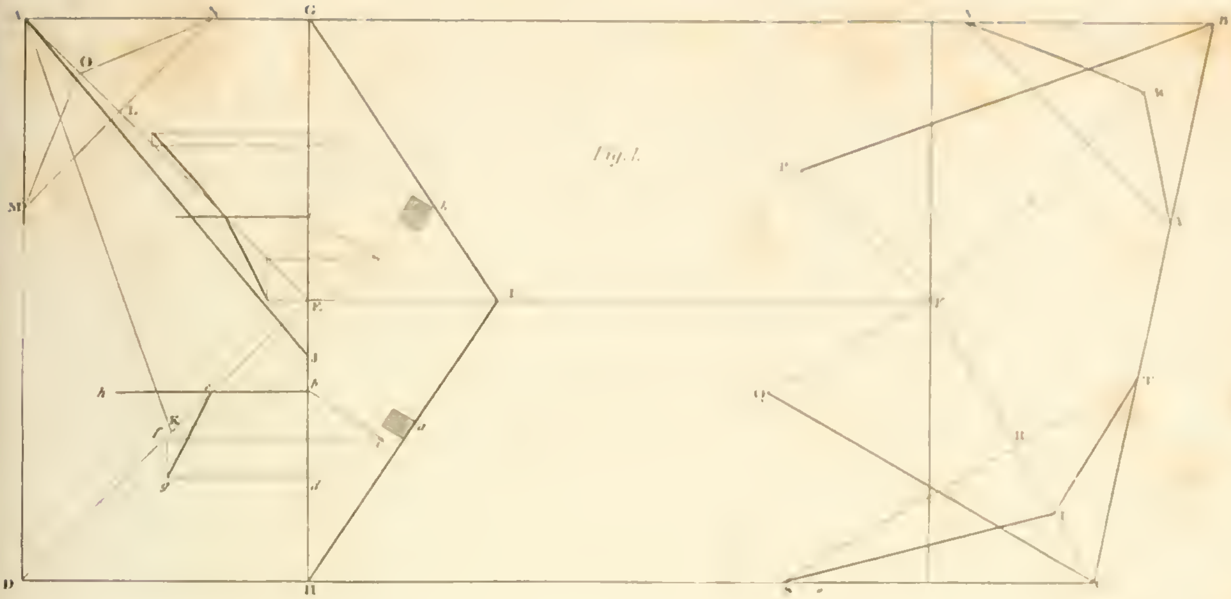


Fig. 3

Fig. 4

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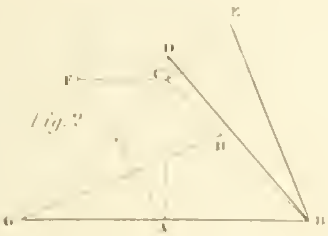
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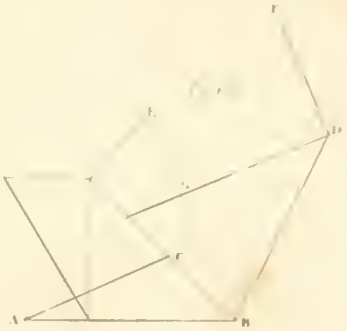


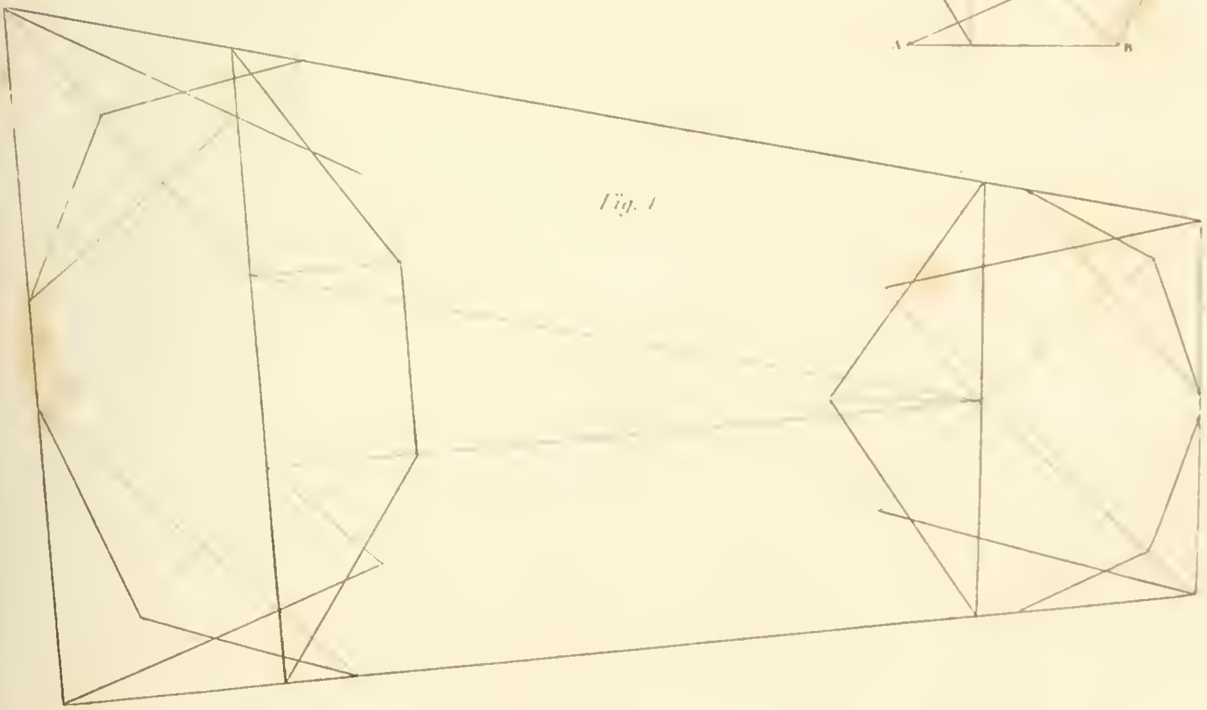
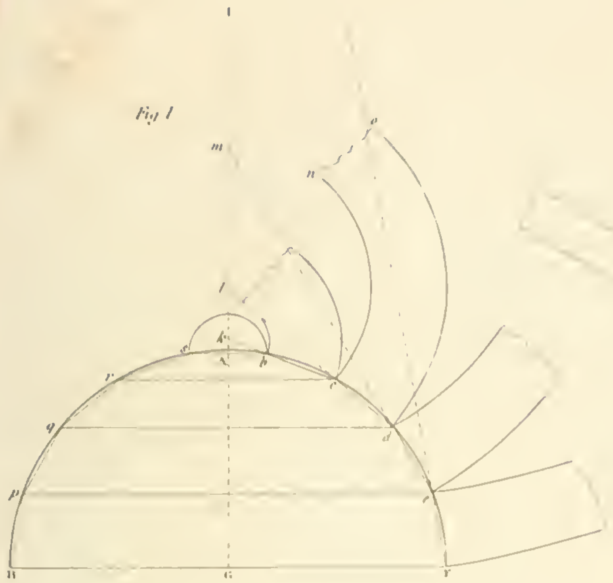


Fig. 4

Fig. 1.



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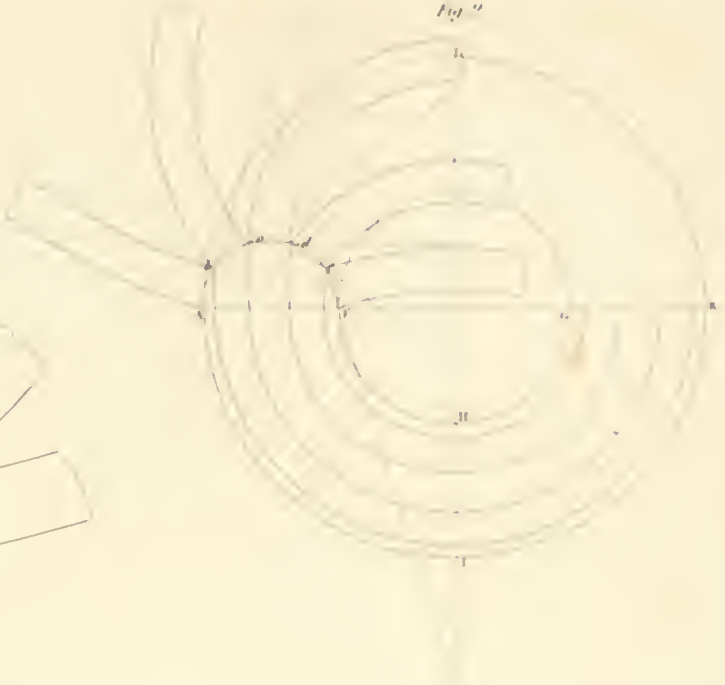

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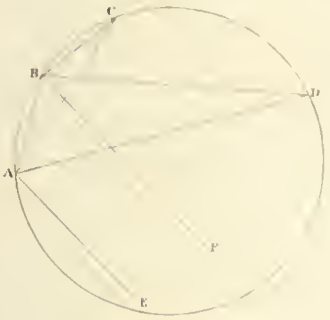

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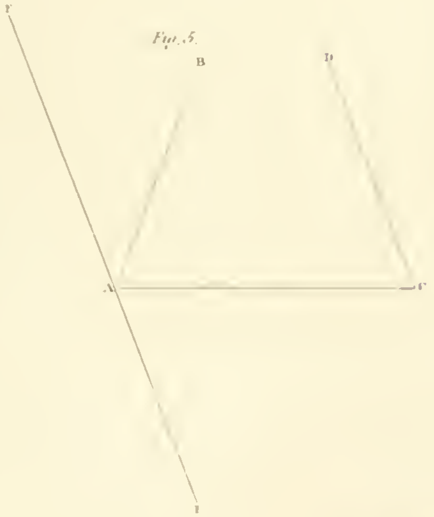

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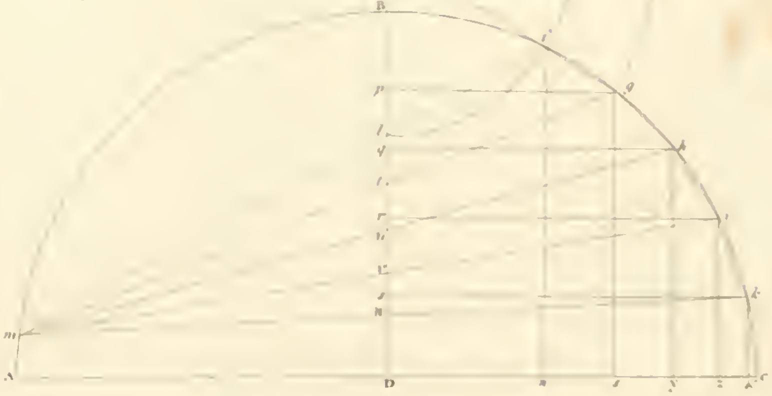

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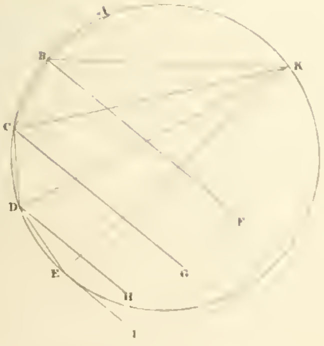

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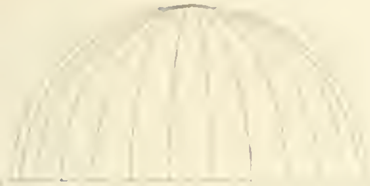

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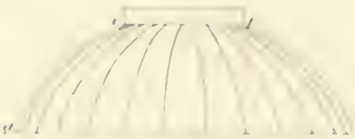

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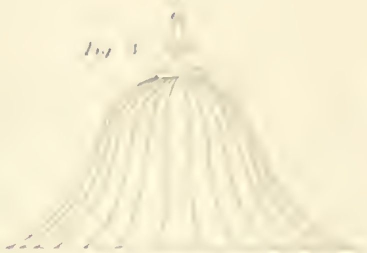

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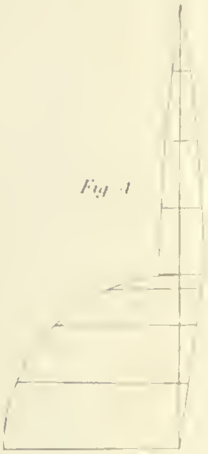

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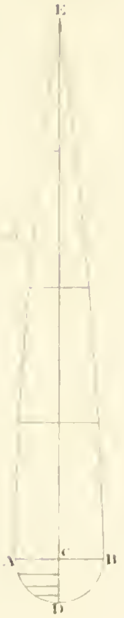

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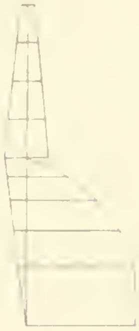

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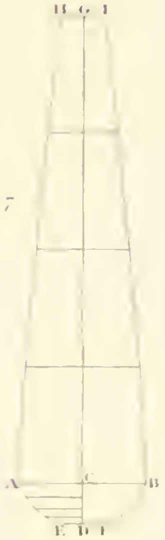

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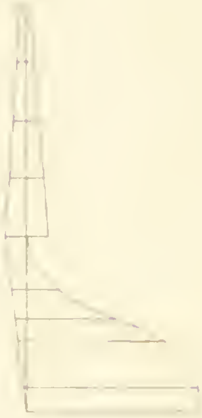

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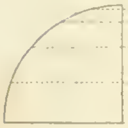

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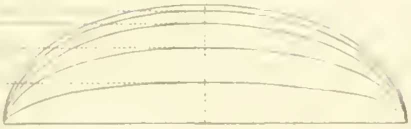

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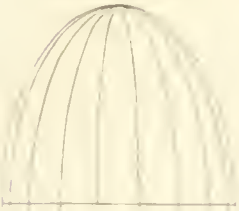

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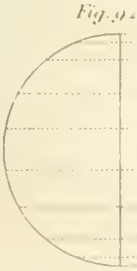

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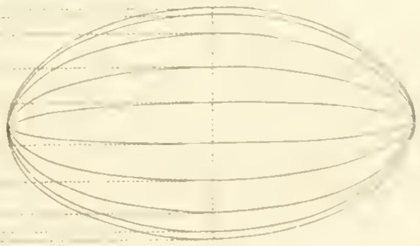


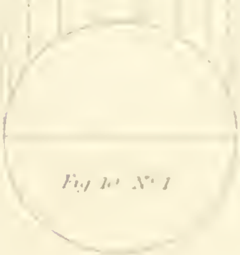
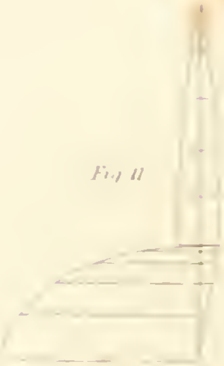


Fig. 10 N° 1

Fig. 11



CARPENTRY.

PLATE CXXV.

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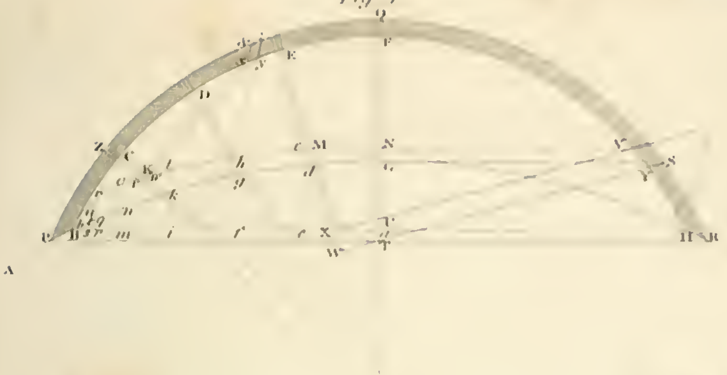

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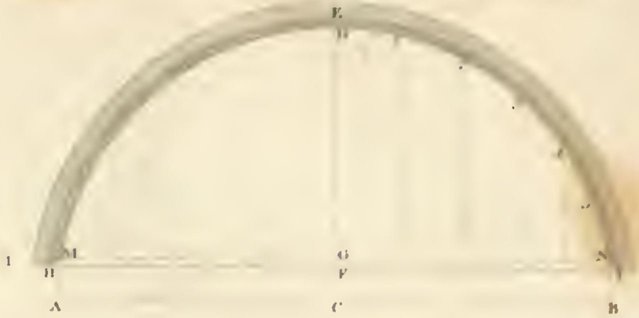

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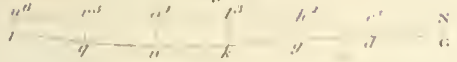

Fig. 4

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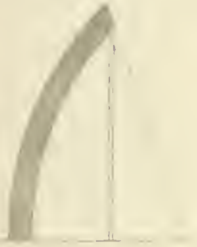

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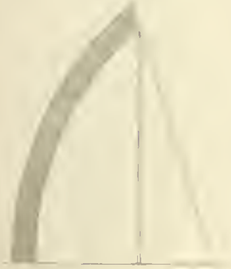

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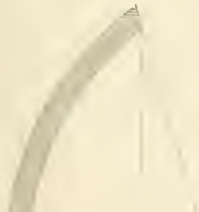

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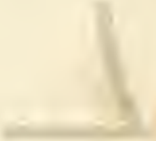

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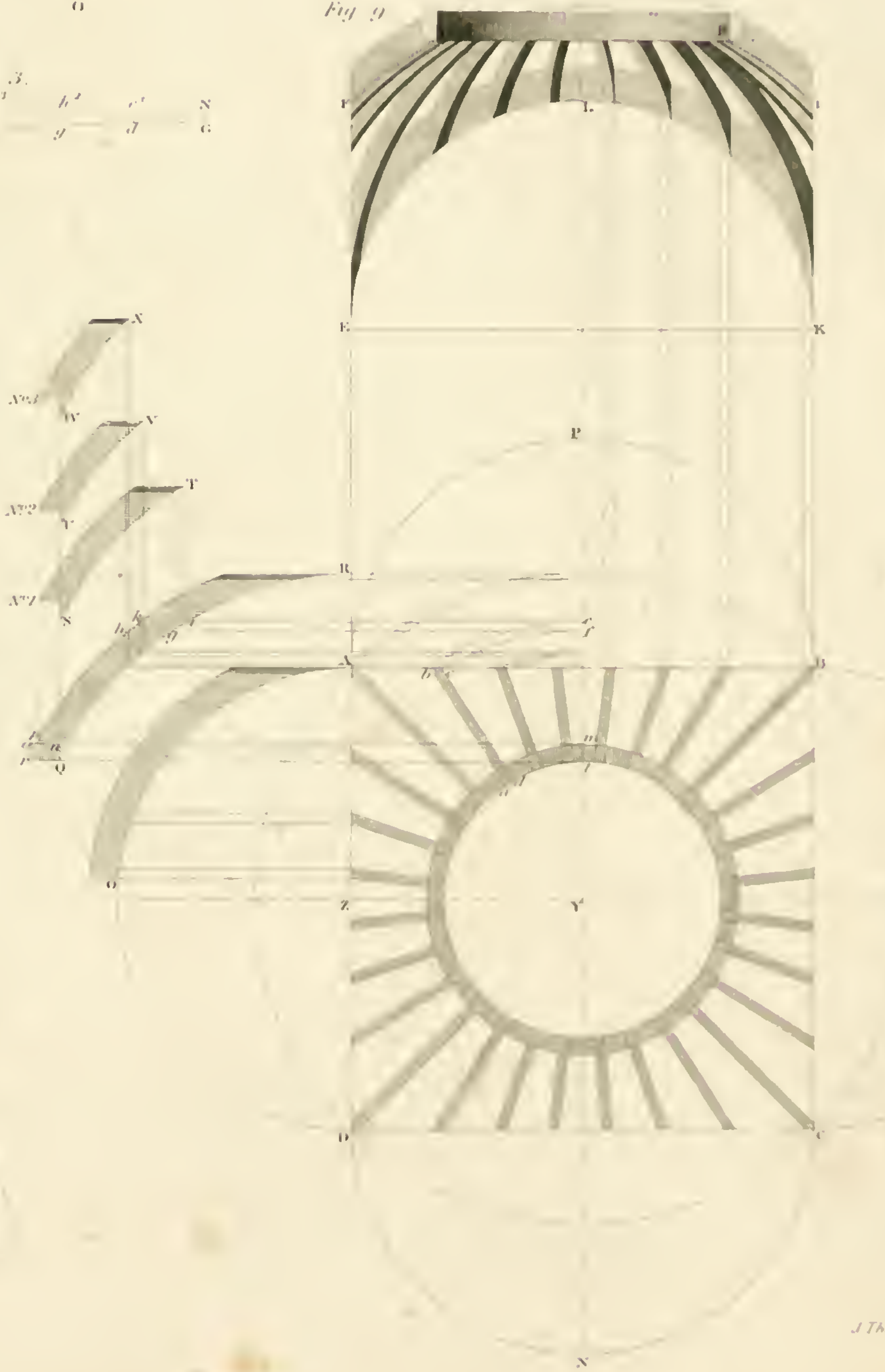
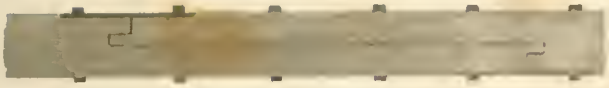


J Thatam sculp.

CARPENTRY. *PLATE CXXII.*

SCARFINGS.

Fig 1



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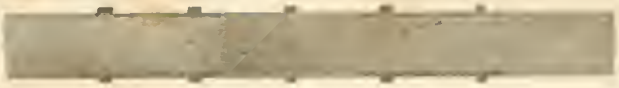

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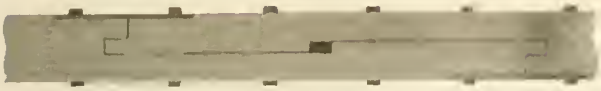

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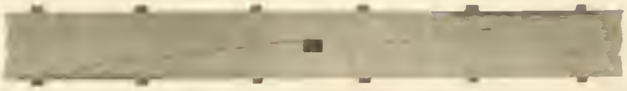

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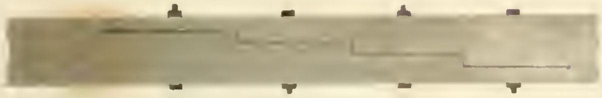

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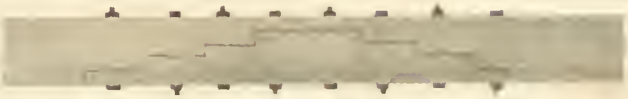

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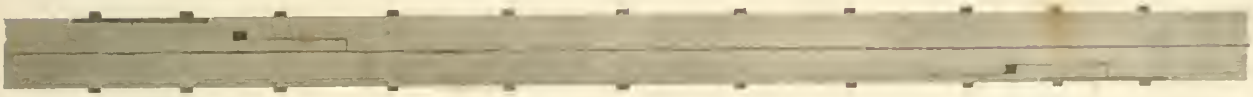

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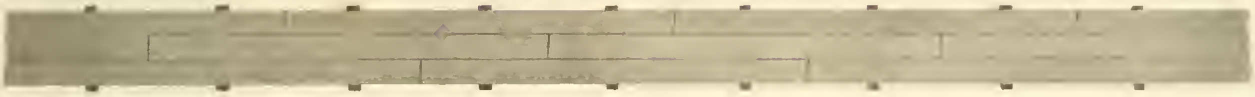

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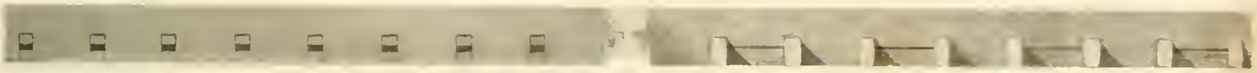

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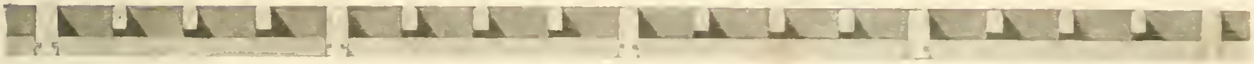

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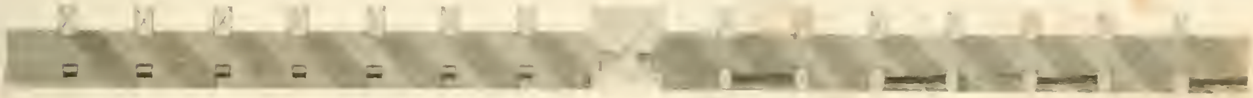

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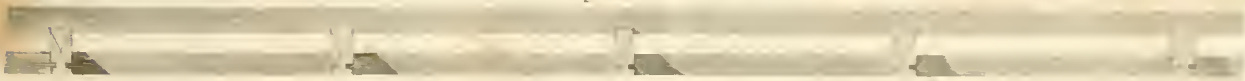

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CARPENTRY.

PLATE CXXVII.

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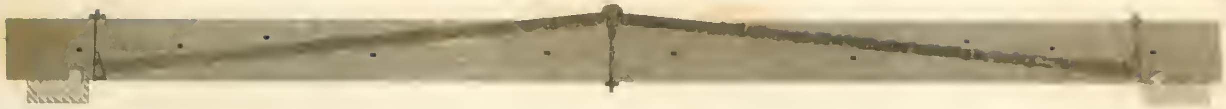

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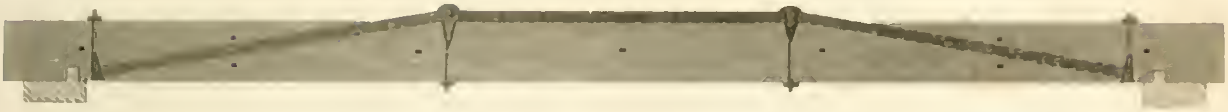
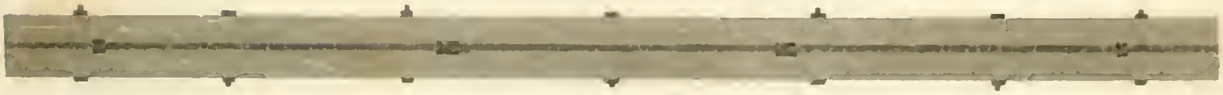


Fig 2 N° 2



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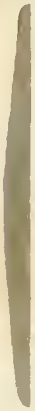

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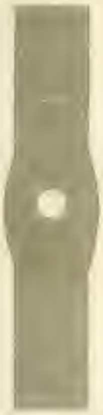

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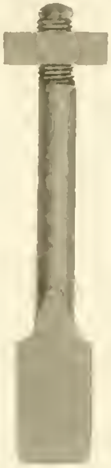

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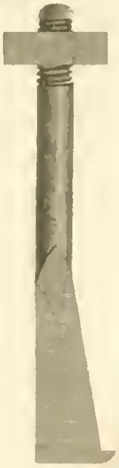

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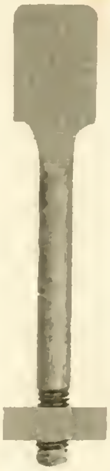

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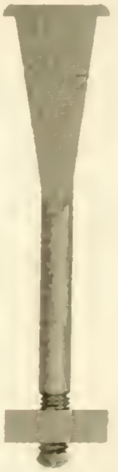

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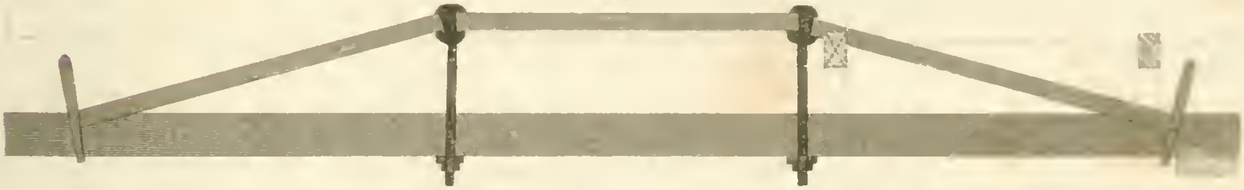

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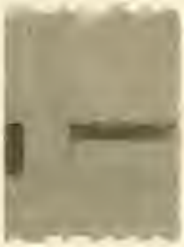

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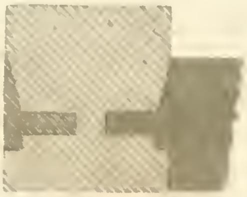

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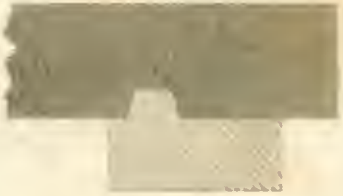

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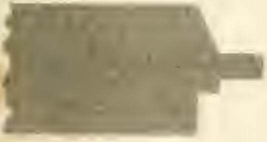

CARPENTRY.

PLATE CXXVIII.

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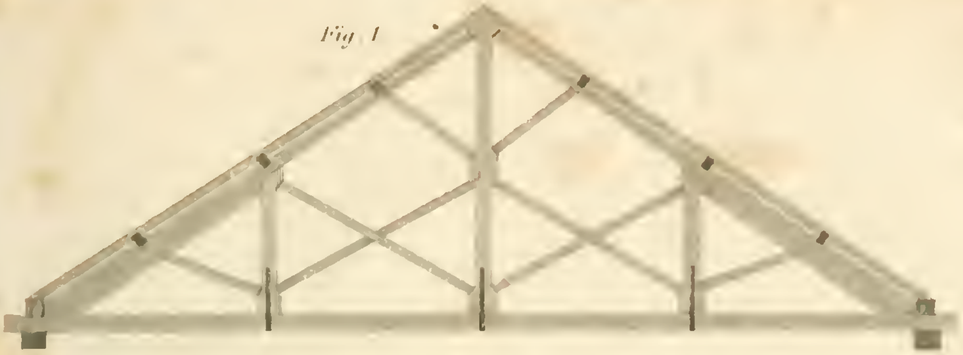

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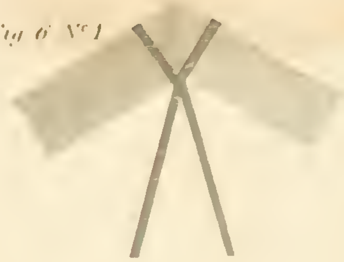
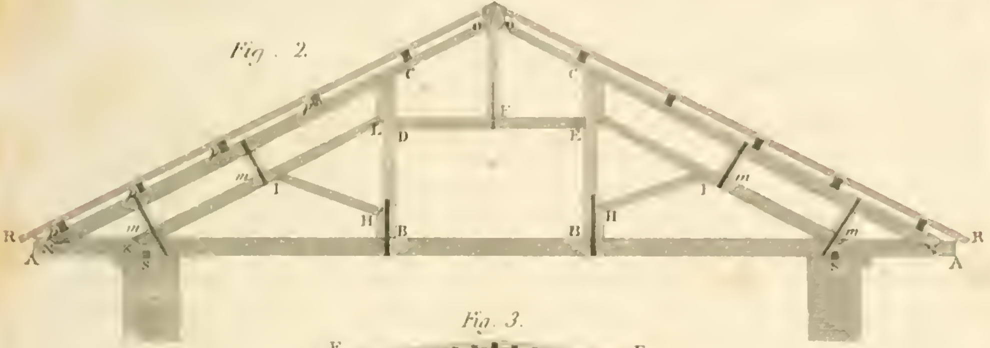


Fig. 2.



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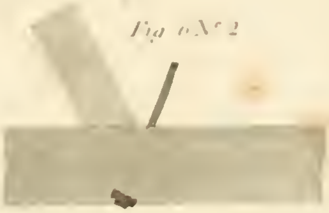

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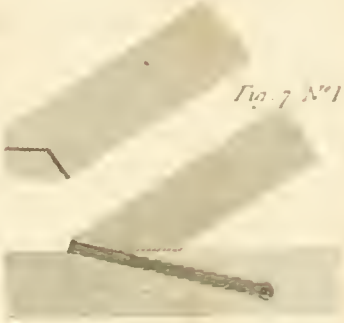
Fig. 7. No. 1



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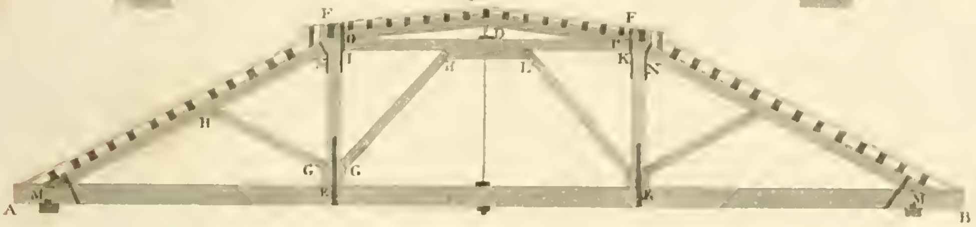

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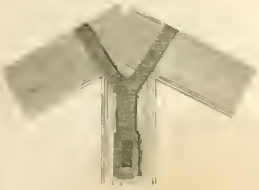

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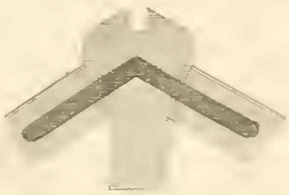

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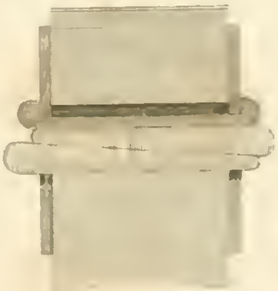

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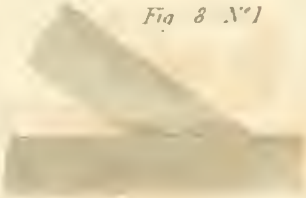

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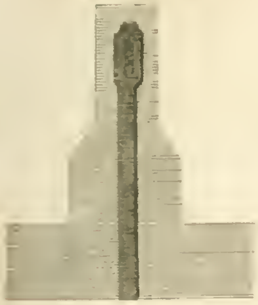

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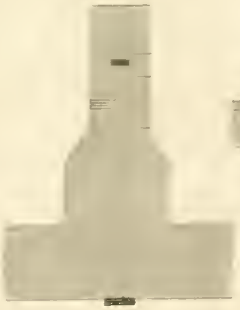

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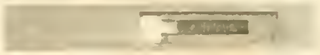

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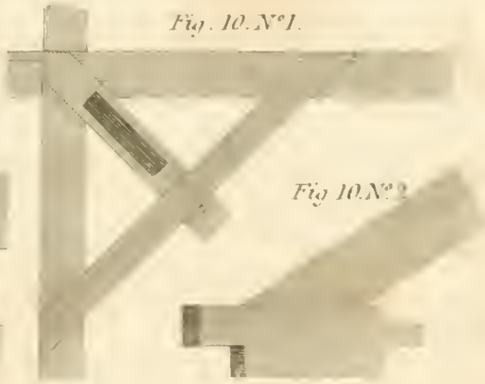
Fig. 10. No. 2



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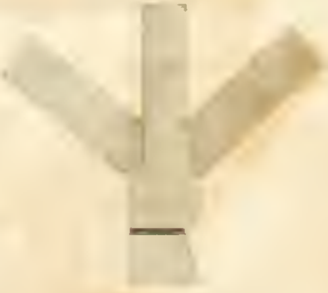

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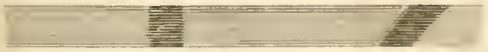
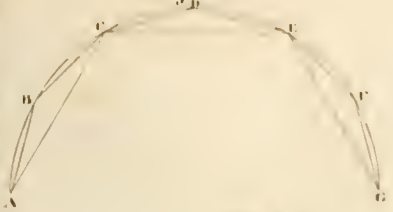


Engraved by W. Charles

Fig. 10.



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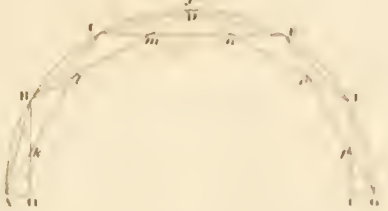
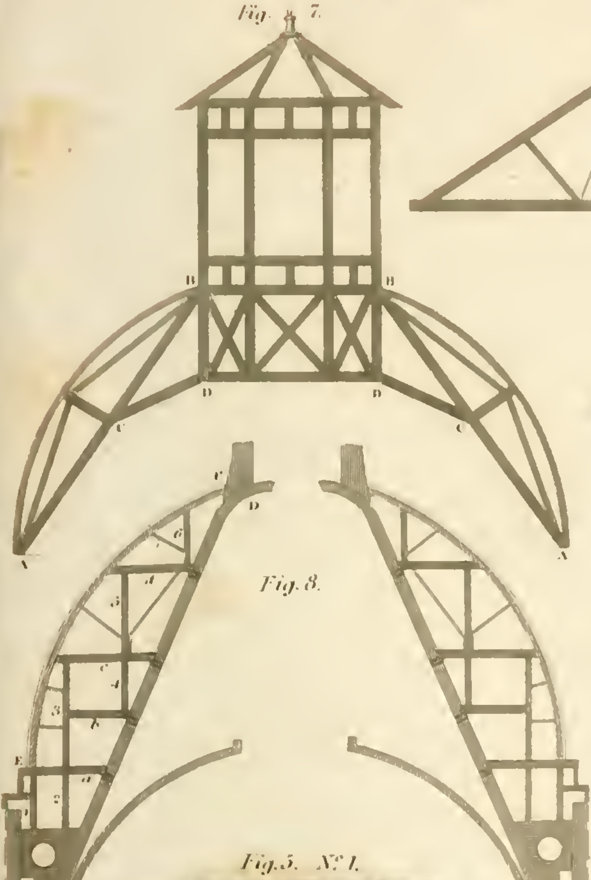


Fig. 12.

Fig. 7. *Fig. 8.*



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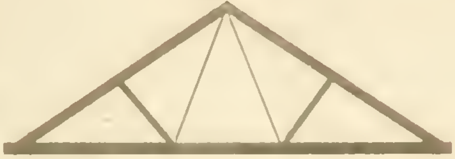

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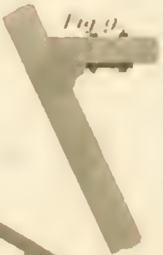

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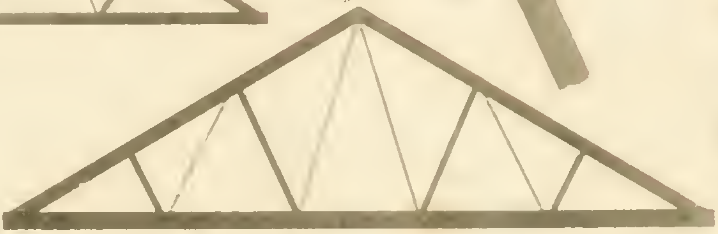

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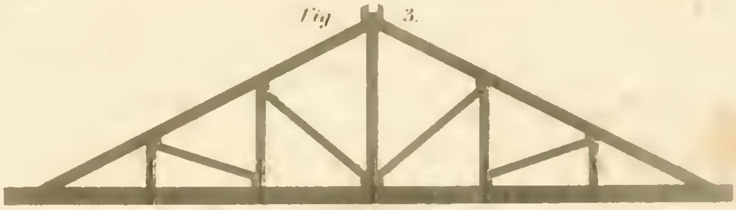

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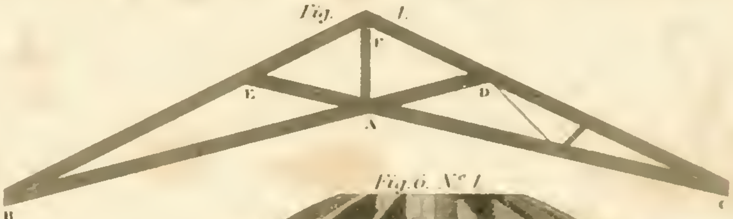

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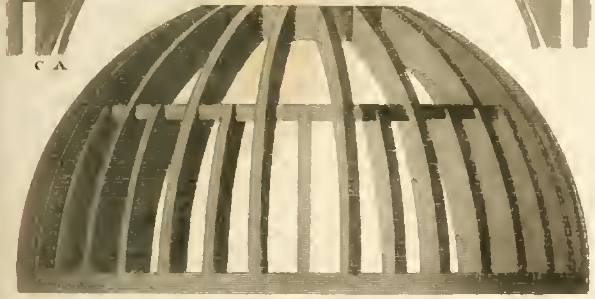

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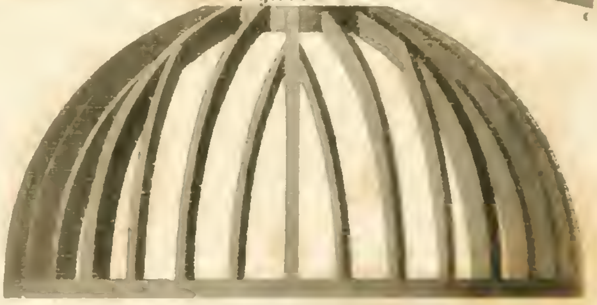

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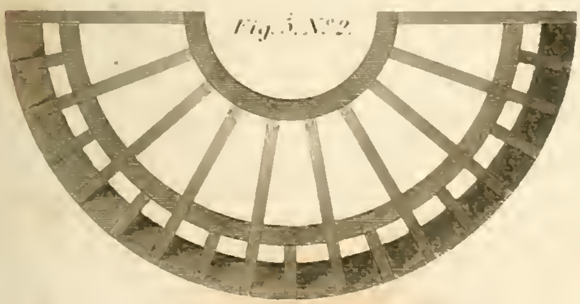

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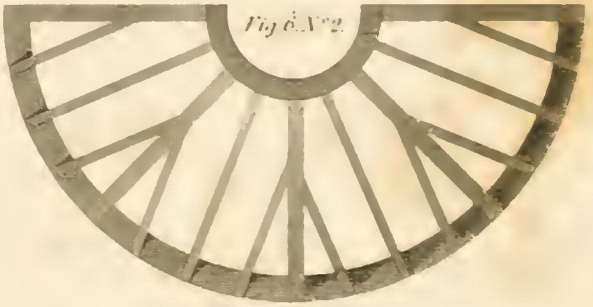


CARPET. PLATE CXXX.

DRAW LOOM OR HARNESS WORK.

Fig. 1

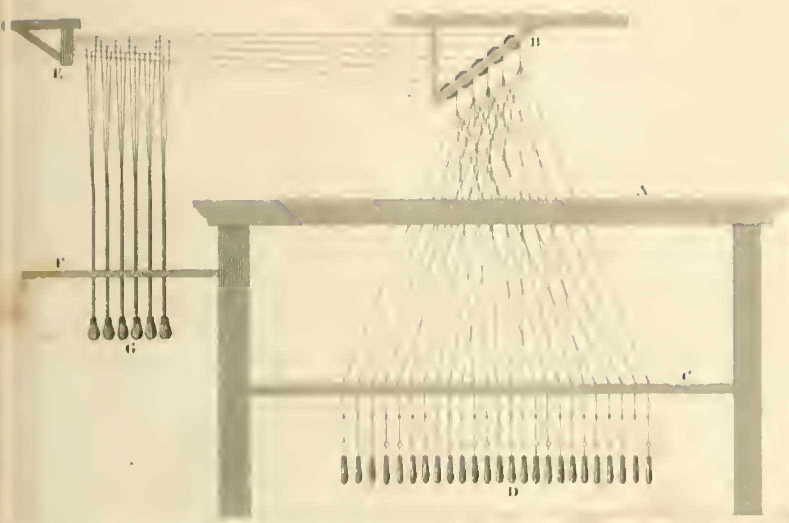


Fig. 2

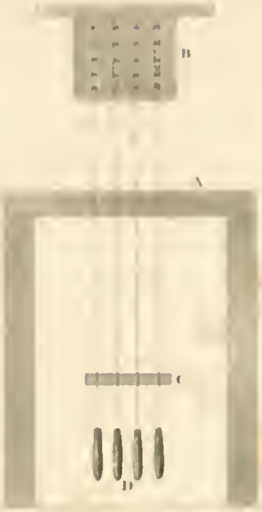
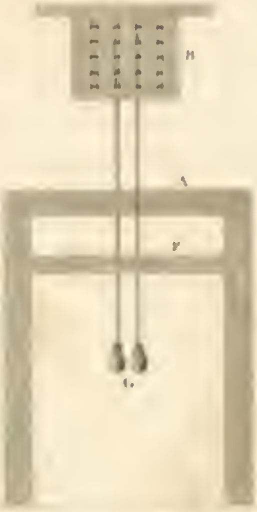


Fig. 3



COMMON DAMASK LOOM.

Fig. 4.

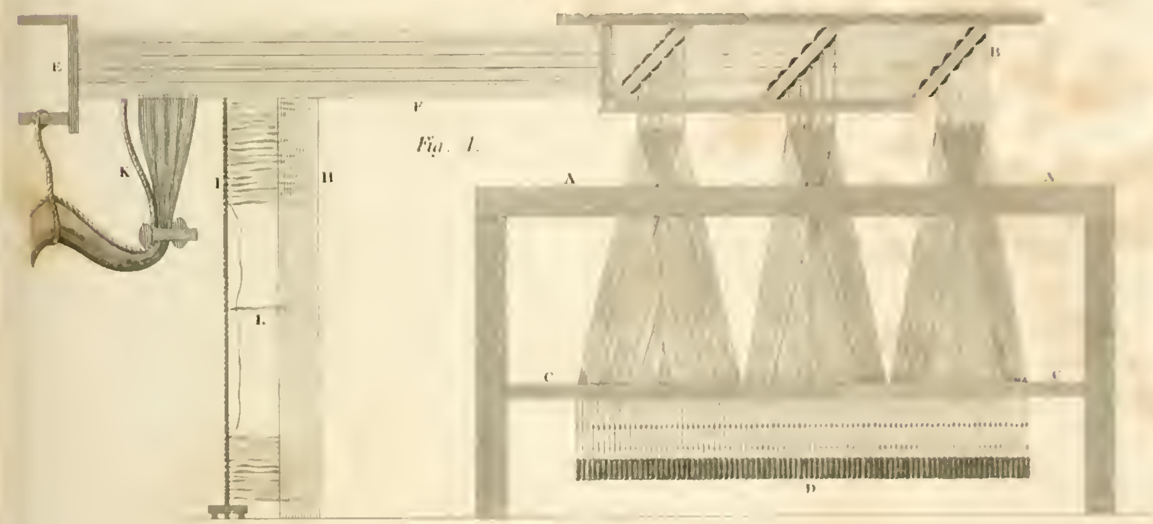
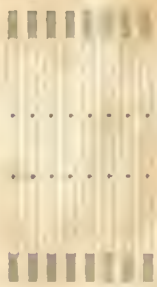


Fig. 5

FRONT LEAVES.



AUTOMATIC CARPET DRAW LOOM.

Envented by John Duncan

Fig. 6.

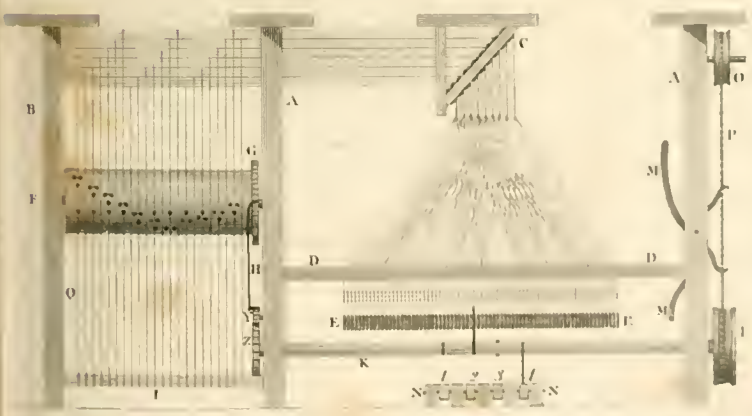
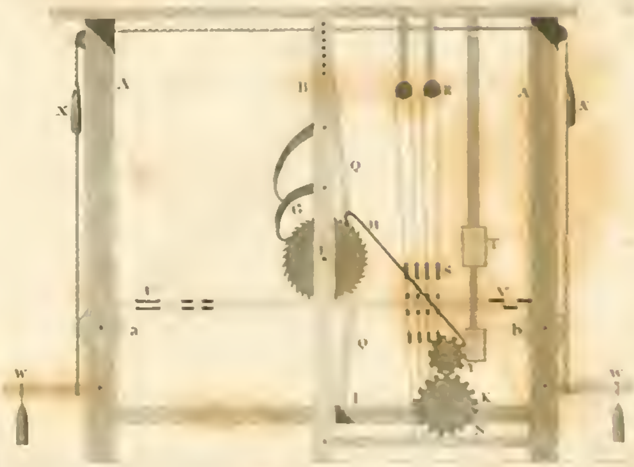


Fig. 7

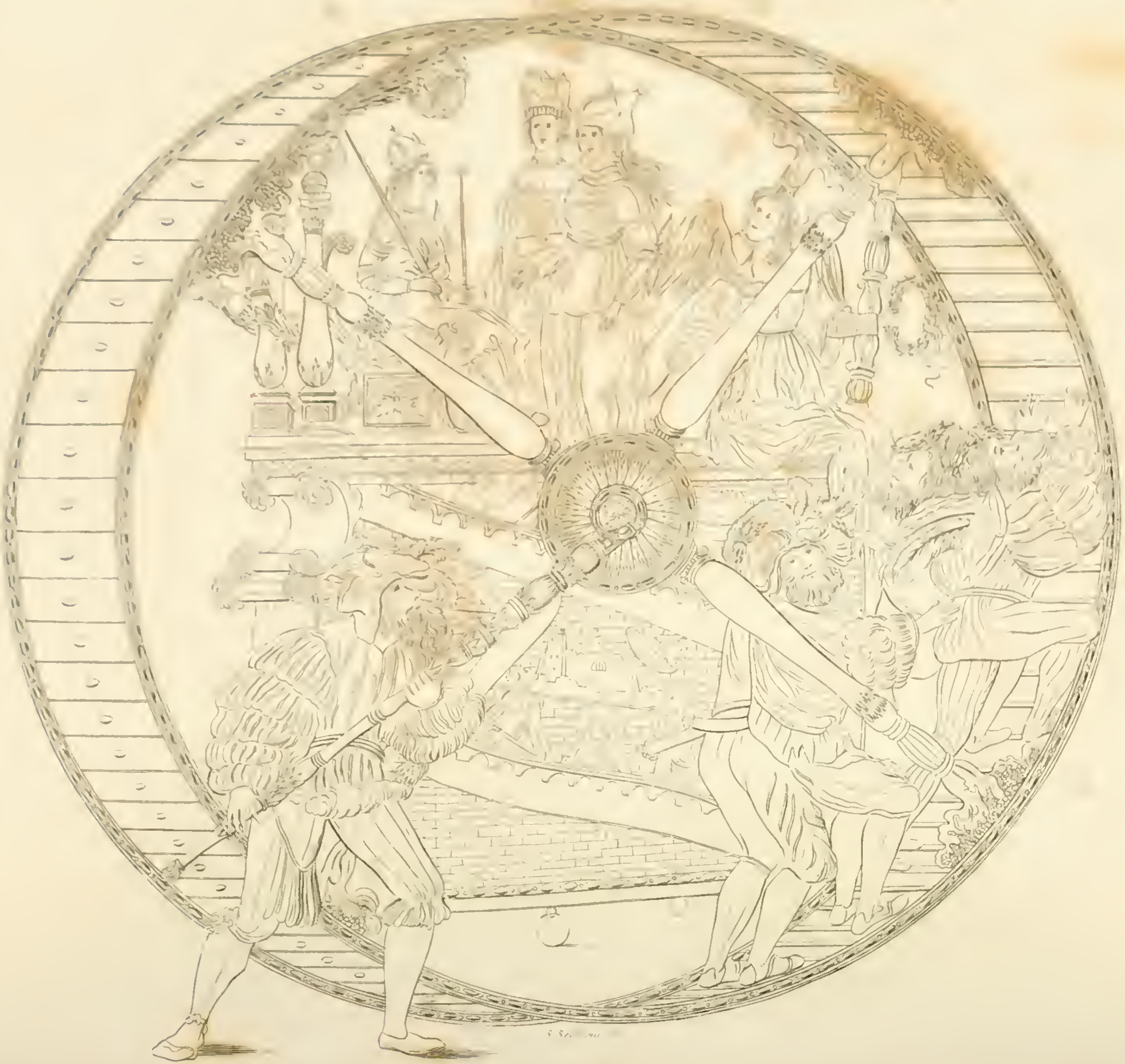


Drawn by John Duncan.

J. Anderson sc.

CARRIAGE.

Representation of [illegible] Carriage



CARRIAGE. *PLATE CXXXII.*

Fig 3

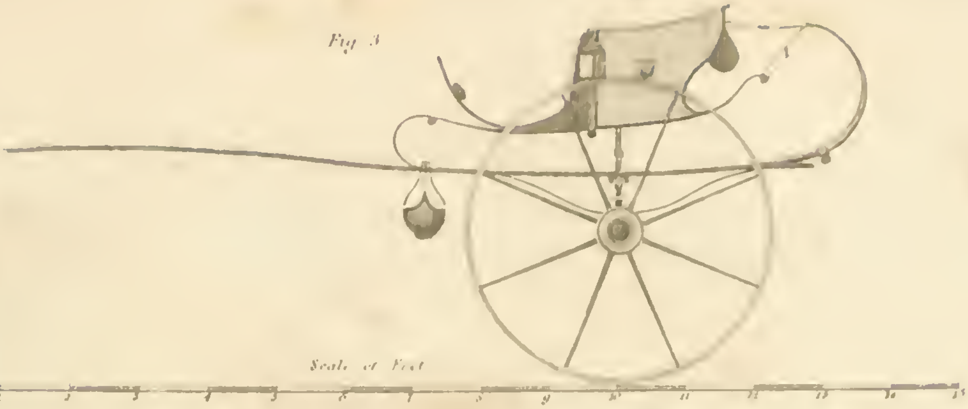
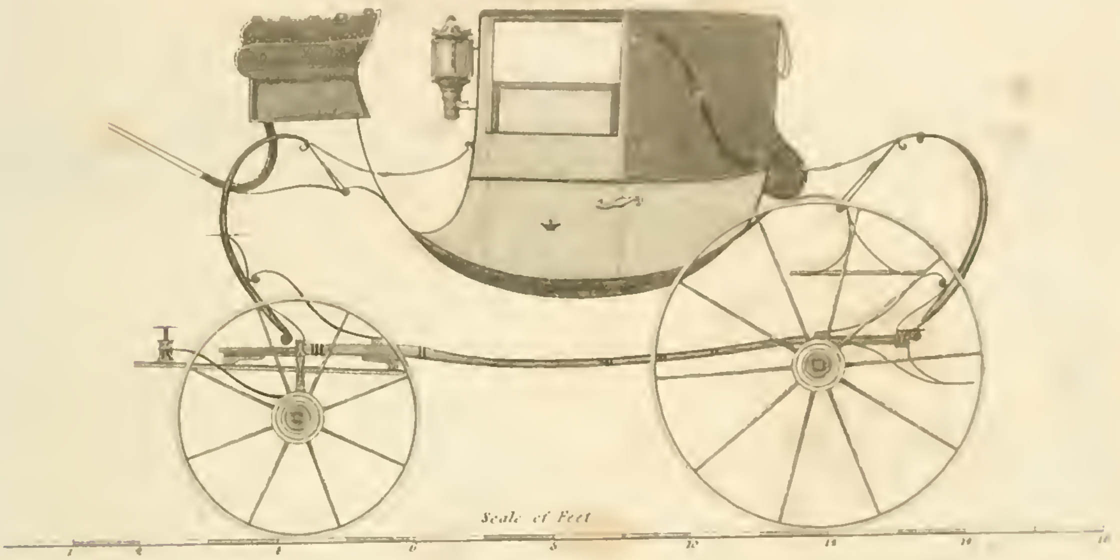


Fig 2



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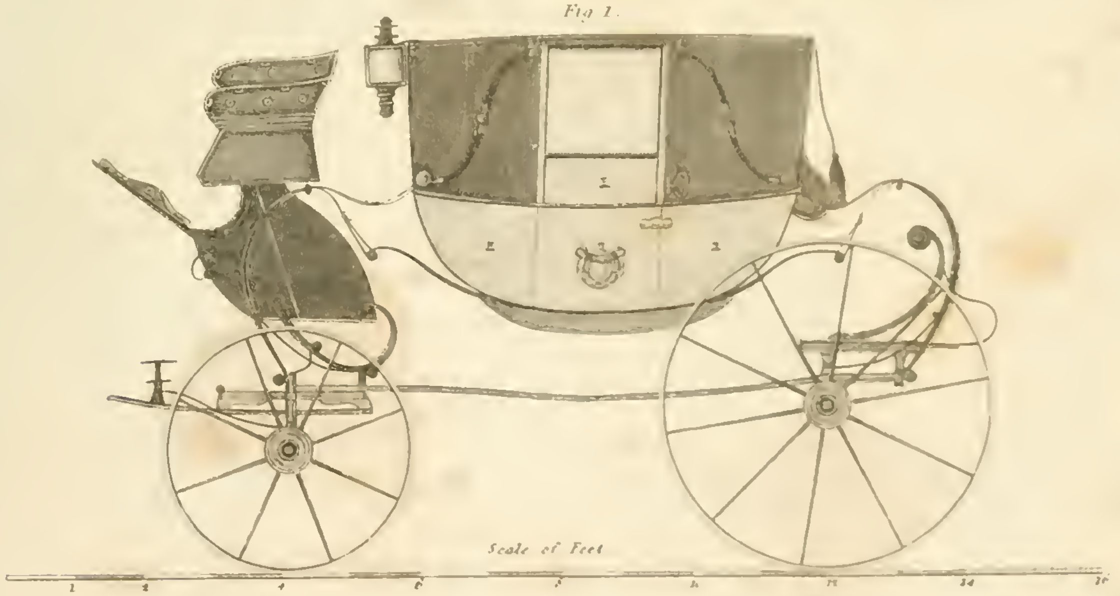


Fig. 1

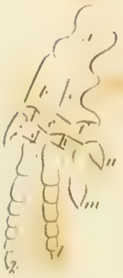


Fig. 2

Fig. 3.

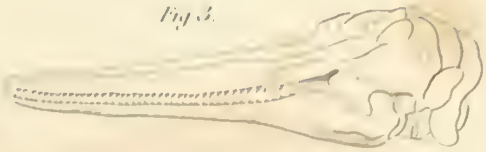


Fig. 5

Fig. 6.

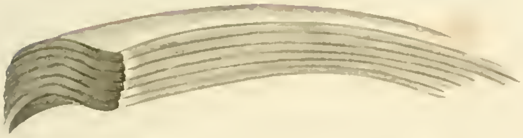
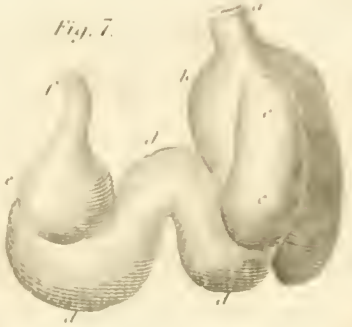


Fig. 4

Fig. 7.



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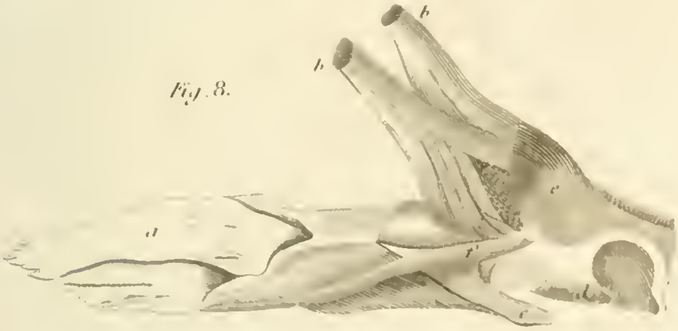


Fig. 9.

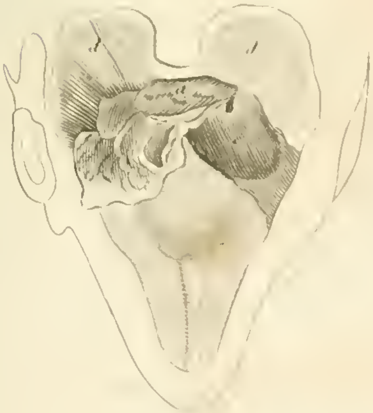
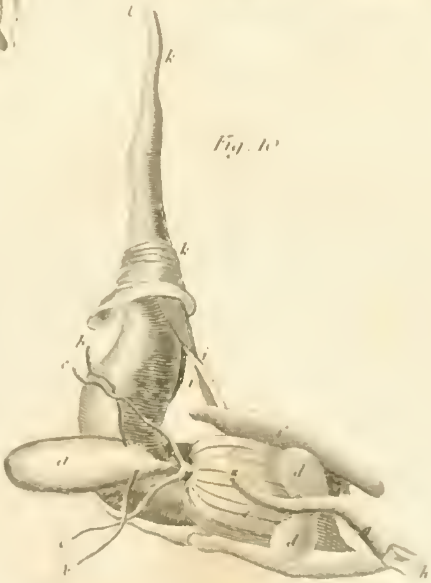


Fig. 10



Nicolas Sc.

CHAFF CUTTER.

PLATE CXXXV.

Fig 1

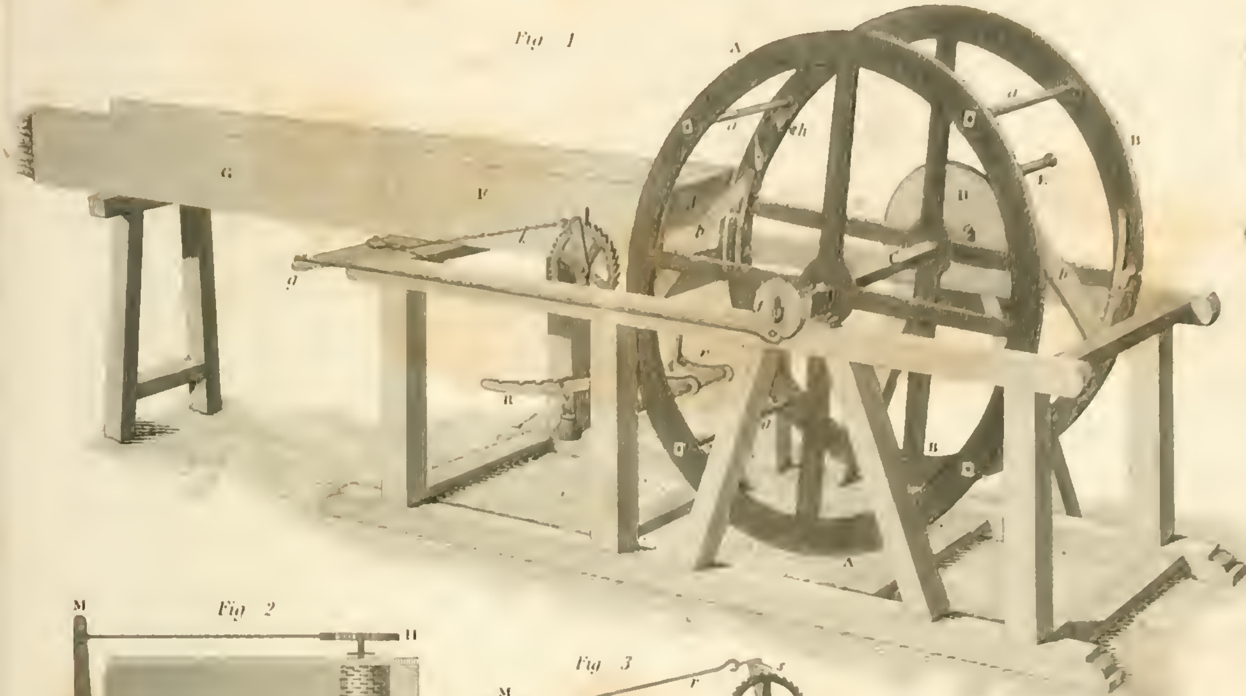


Fig 4

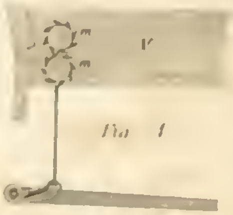


Fig 5

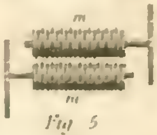


Fig 2

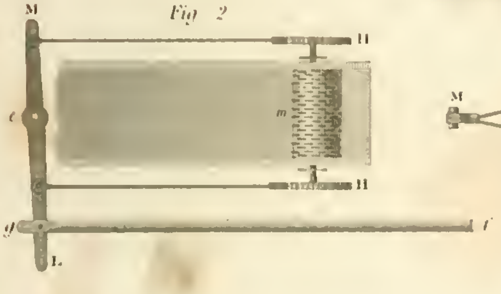


Fig 3

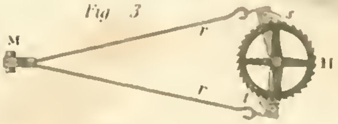
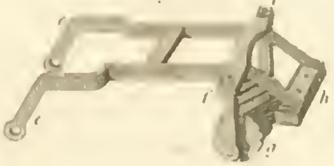


Fig 8



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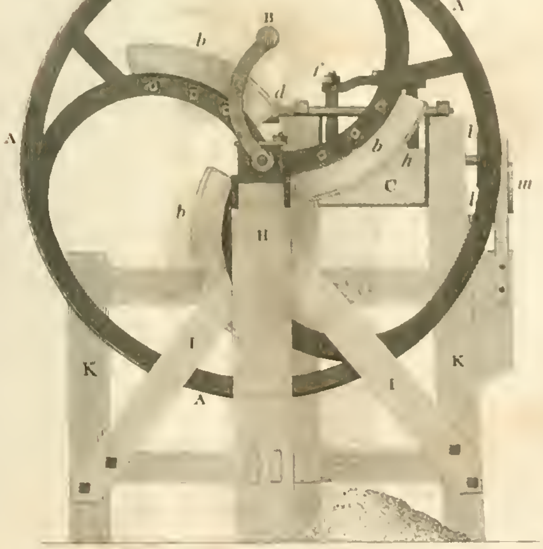
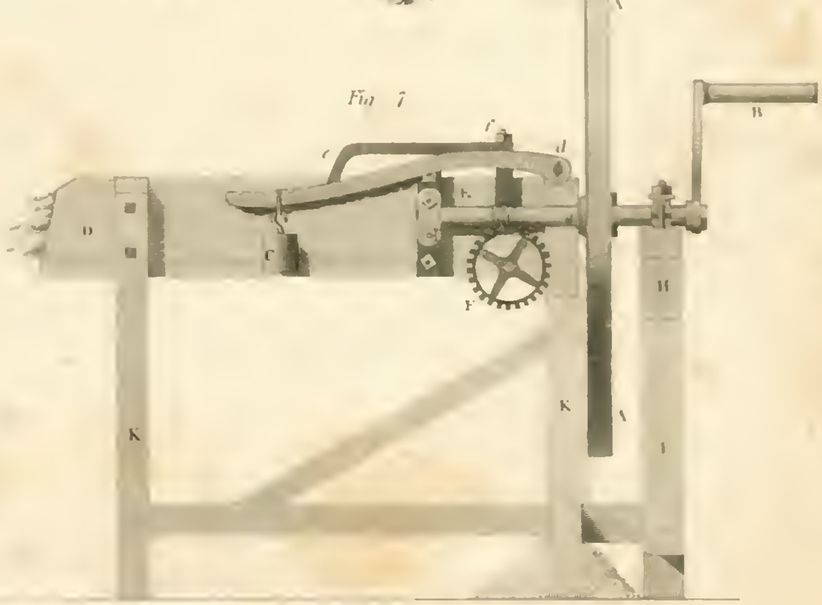


Fig 7



Drawn by J. Farey Junr

H. Anderson sc.

CHAINWORK. PLATE CXXXVI.

TAMBOURING-MACHINE.

Fig. 1.

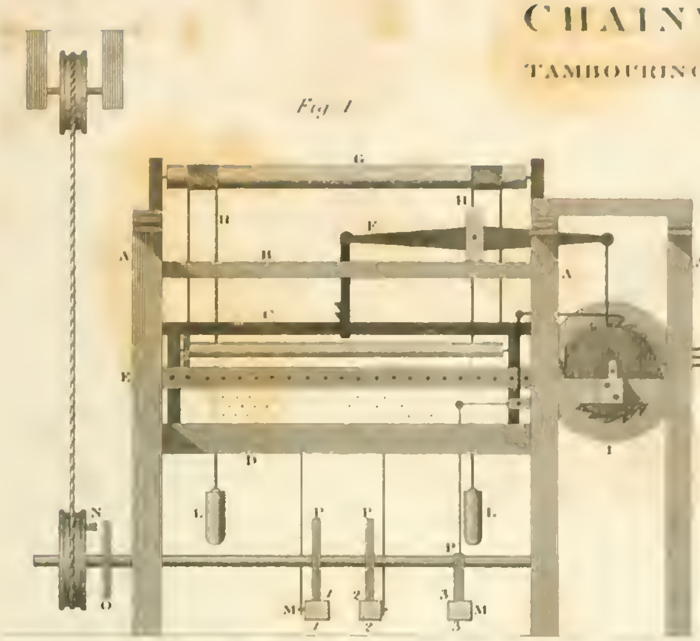


Fig. 2.

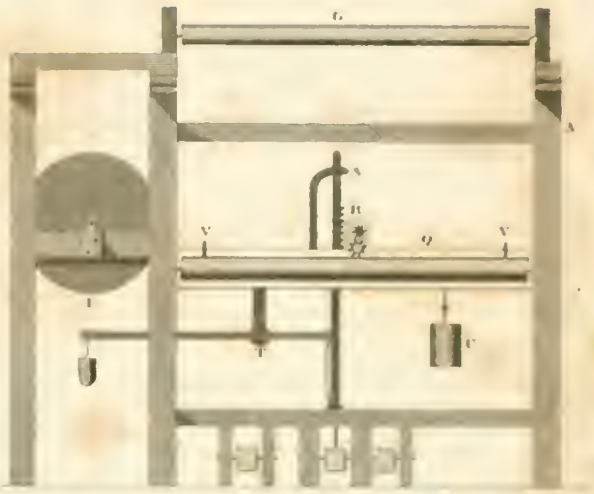


Fig. 4.

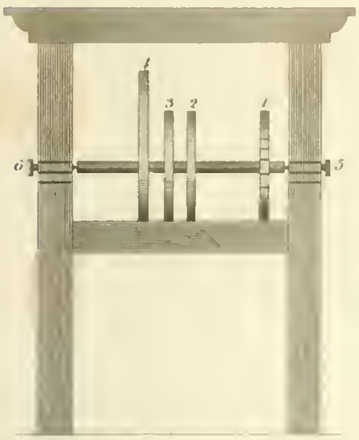
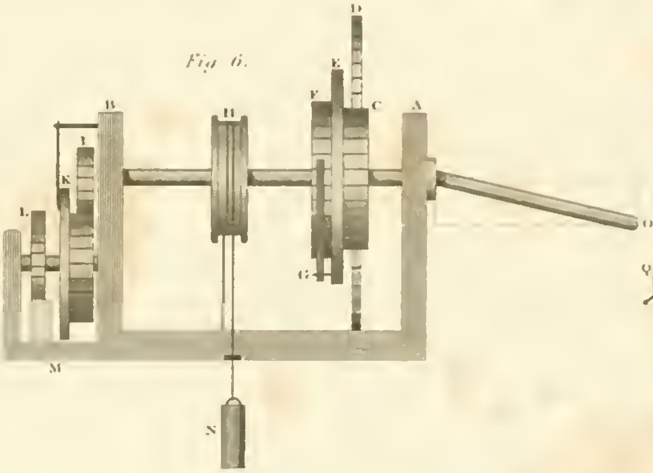


Fig. 6.



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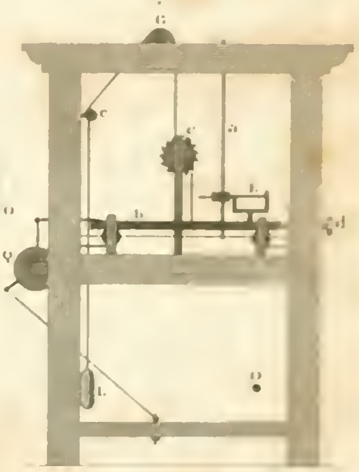
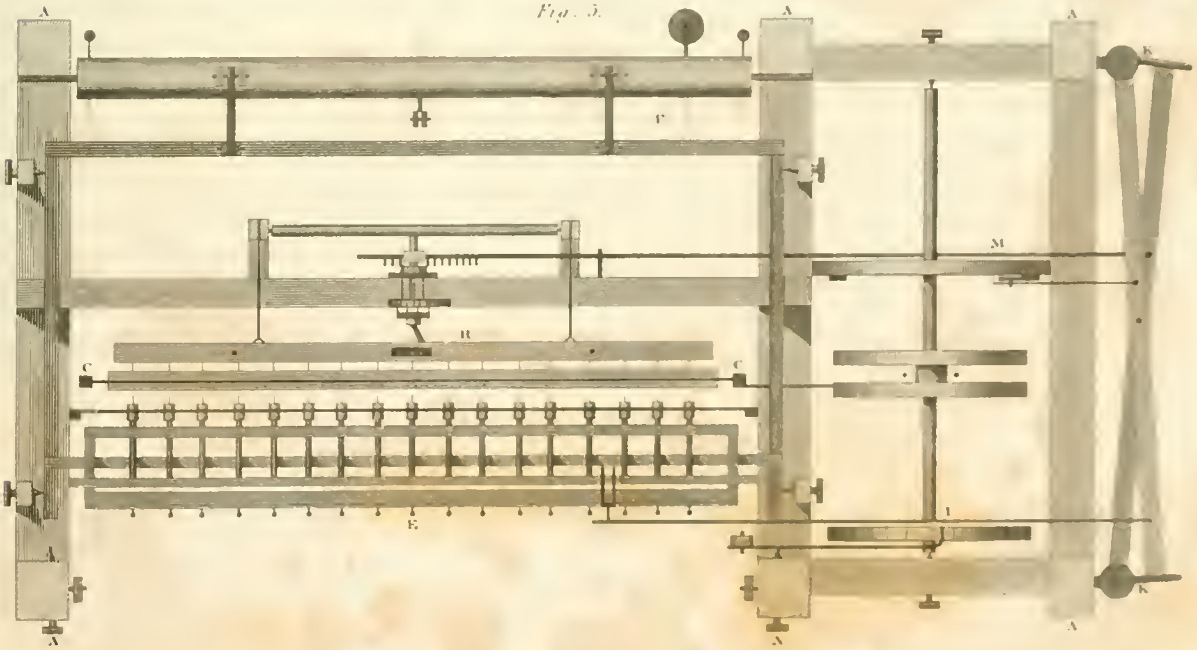


Fig. 5.



CHAINWORK.

PLATE CXXXVII.

Fig. 1.

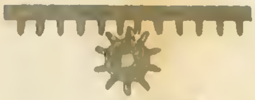


Fig. 2.

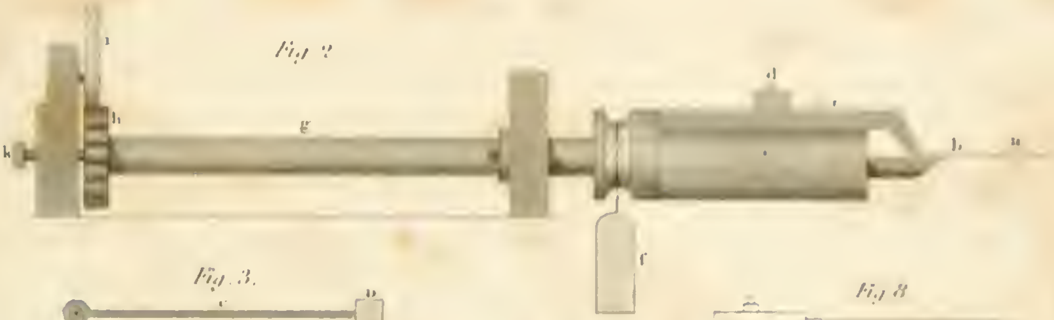
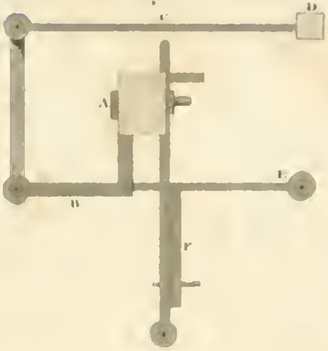


Fig. 3.



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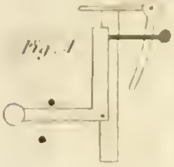
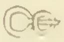


Fig. 5.



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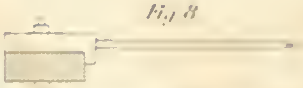

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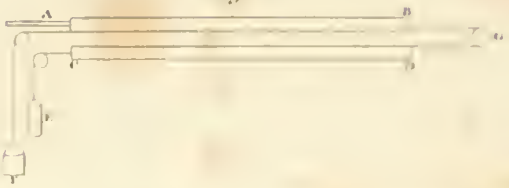

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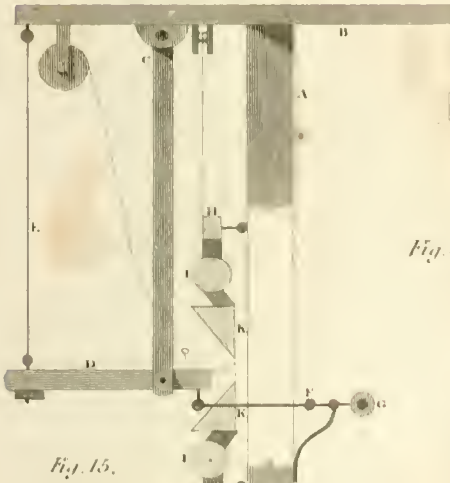

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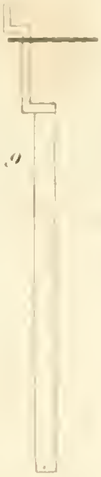

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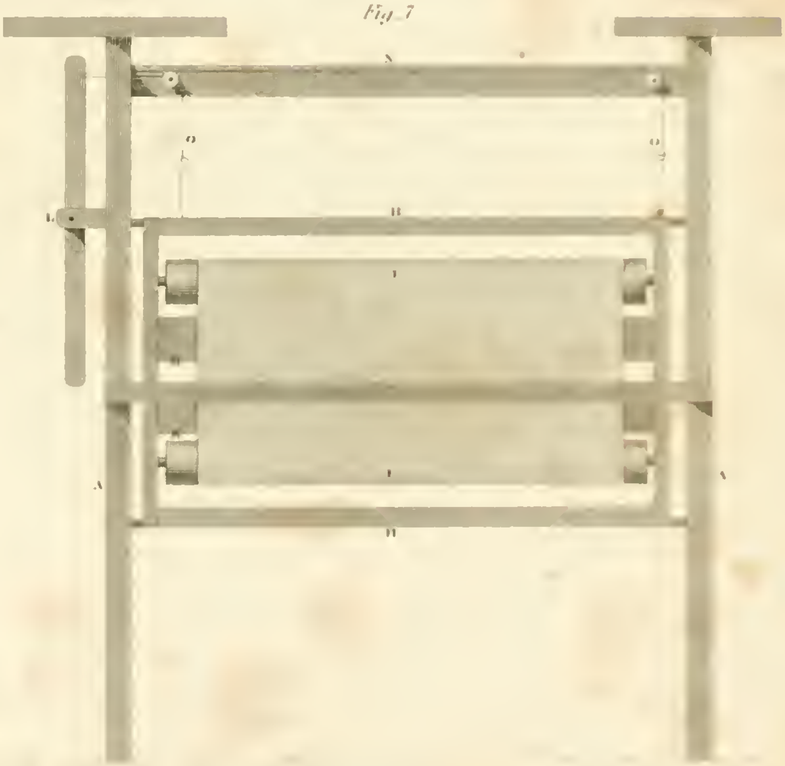

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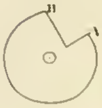


Fig. 13.

Fig. 16.

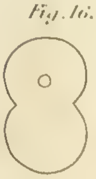
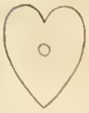


Fig. 17.



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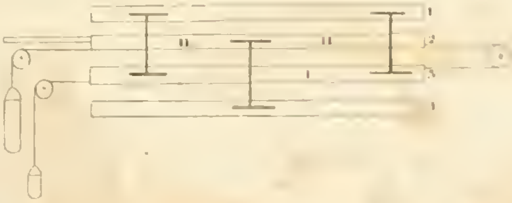

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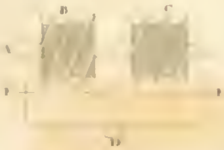

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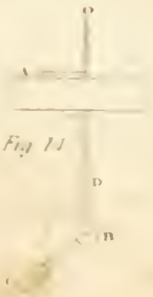
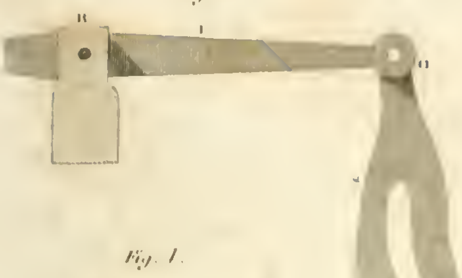


CHAINWORK.
STOCKING MANUFACTURE.

PLATE CXXXVIII.

Fig 3



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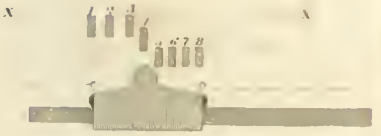


COMMON FRAME.

Fig 1

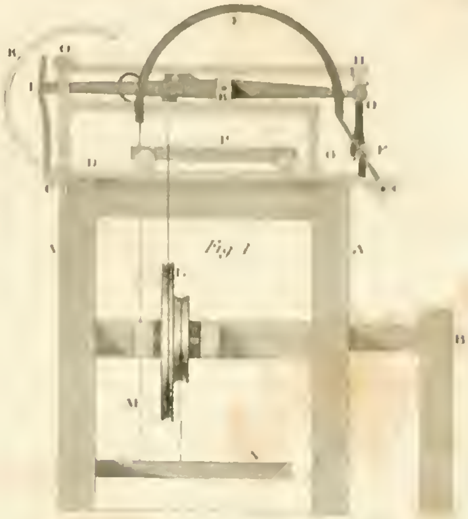
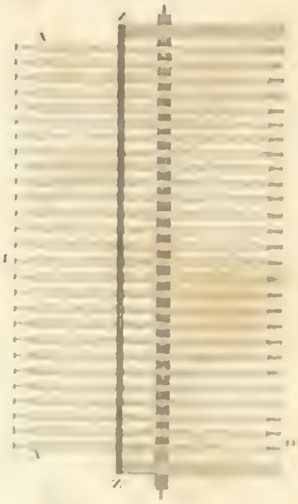


Fig 2



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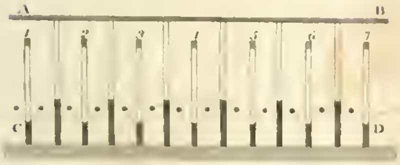

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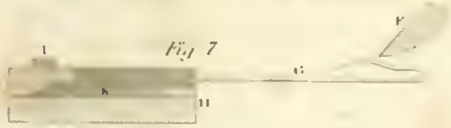

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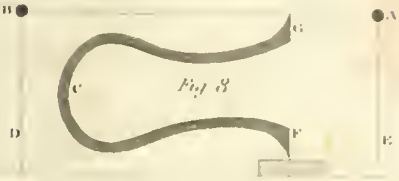


RIB STOCKING FRAME.

Fig 5

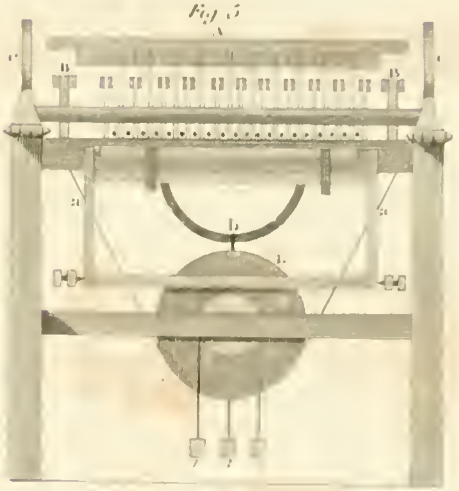
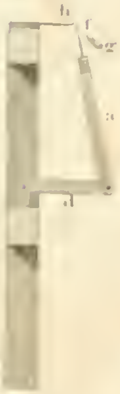
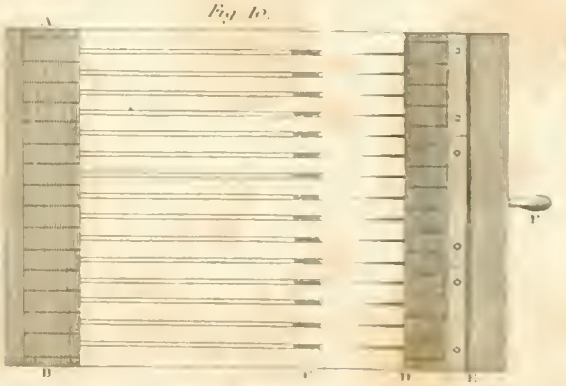


Fig 9



PLATED STOCKING FRAME.

Fig 10.



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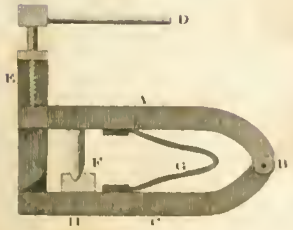
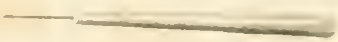


Fig 12

Fig 13.

Fig 14



CHAINWORK.

PLATE CXXXIX.

Fig 1.

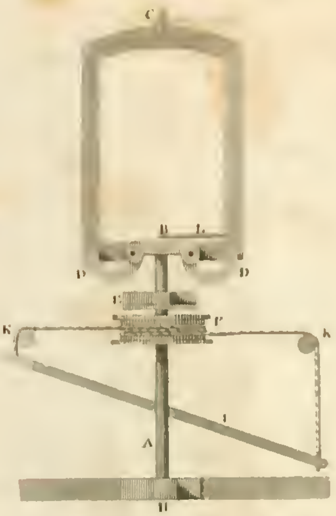
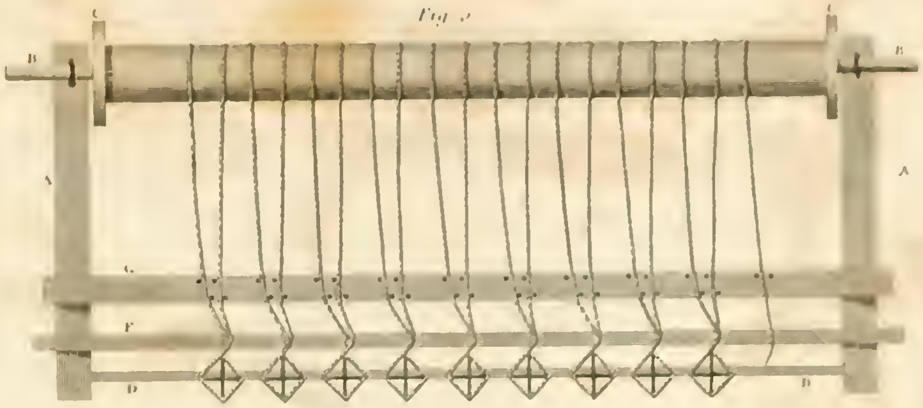


Fig 5



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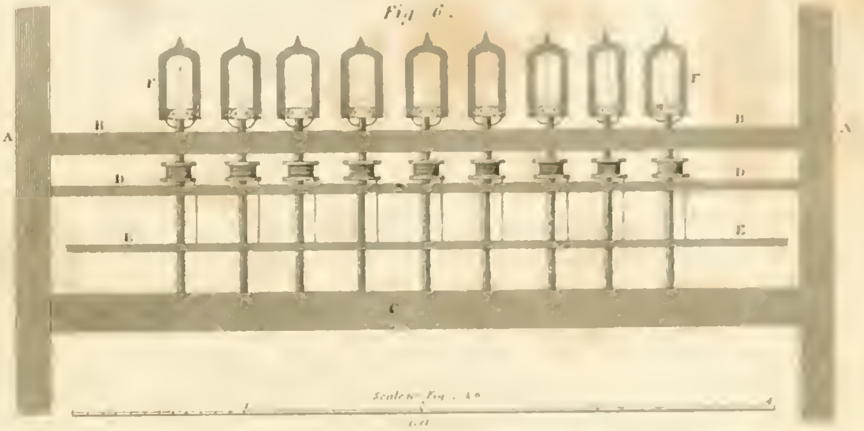

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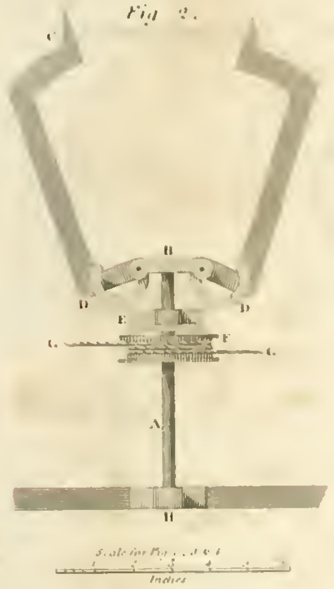

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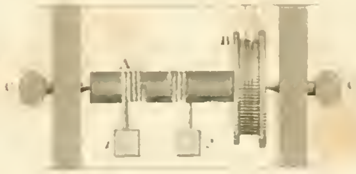

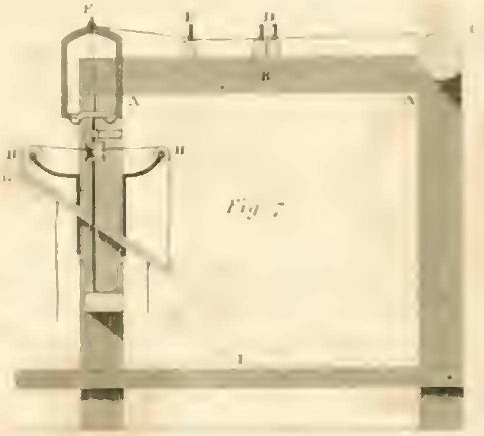

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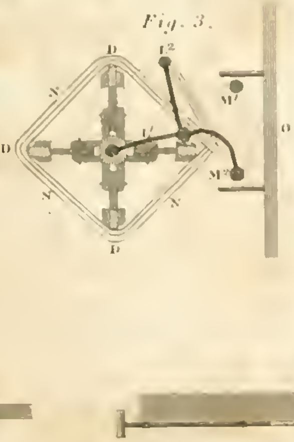

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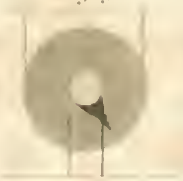

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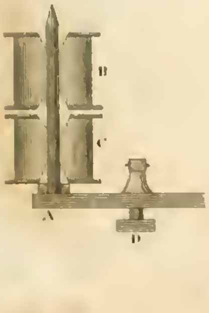

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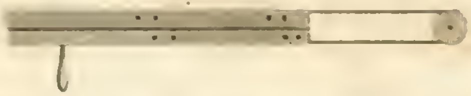

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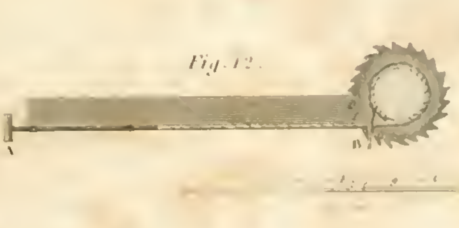
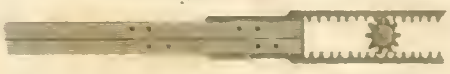


Fig 11

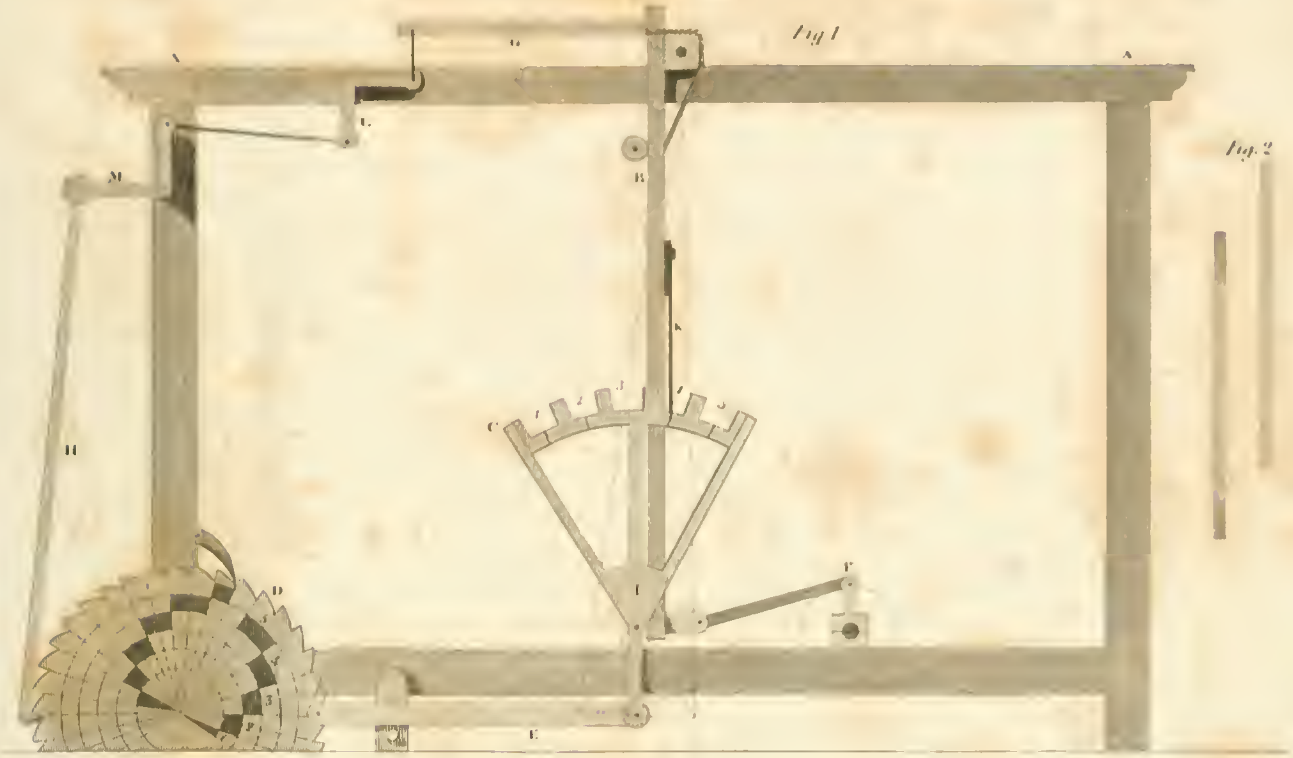


I.J.Pinches

CHECK. CHARACTER. PLATE CXL.

CHECK AND DUPLICATE LAY FOR POWER LOOMS.

Invented by John Duncan



EXAMPLES OF DIFFERENT NUMERAL CHARACTERS.

HEBREW NUMERALS.

א	1	י	10	ק	100
ב	2	כ	20	ר	200
ג	3	ל	30	ש	300
ד	4	מ	40	ת	400
ה	5	נ	50	ך	500
ו	6	ס	60	ם	600
ז	7	ע	70	ן	700
ח	8	פ	80	ף	800
ט	9	צ	90	ץ	900

פד 84 אתיב 1812

GREEK NUMERALS.

α	1	ι	10	ρ	100
β	2	κ	20	σ	200
γ	3	λ	30	τ	300
δ	4	μ	40	υ	400
ε	5	ν	50	φ	500
ϛ	6	ξ	60	χ	600
ζ	7	ο	70	ψ	700
η	8	π	80	ω	800
θ	9	ϟ	90	ϡ	900

αωιβ 1812

SPECIMEN OF THE GREEK *MULTIPLICATION TABLE.*

α	β	γ	δ	ε	ϛ	ζ	η	θ
β	δ	ϛ	η	ι	ιβ	ιδ	ιϛ	ιη
γ	ϛ	θ	ιβ	ιε	ιη	κα	κδ	κζ
δ	η	ιβ	ιϛ	κ	κδ	κη	λβ	λϛ
ε	ι	ιε	κ	κε	λ	λε	μ	με
ϛ	ιβ	ιη	κδ	λ	λϛ	μβ	μη	νδ
ζ	ιδ	κα	κη	λε	μβ	μθ	νϛ	ξγ
η	ιϛ	κδ	λβ	μ	μη	νϛ	ξδ	οβ
θ	ιη	κζ	λϛ	με	νδ	ξγ	οβ	πα

ANCIENT ARABIC *NUMERALS.*

١	1	٧	7
٢	2	٨	8
٣	3	٩	9
٤	4	١٠	10
٥	5	٢٥	25
٦	6	٦٥	65

INDIAN *NUMERALS.*

१	1	७	7
२	2	८	8
३	3	९	9
४	4	१०	10
५	5	२५	25
६	6	६५	65

SIAMESE *NUMERALS.*

๑	1	๖	6
๒	2	๗	7
๓	3	๘	8
๔	4	๙	9
๕	5	๑๐	10

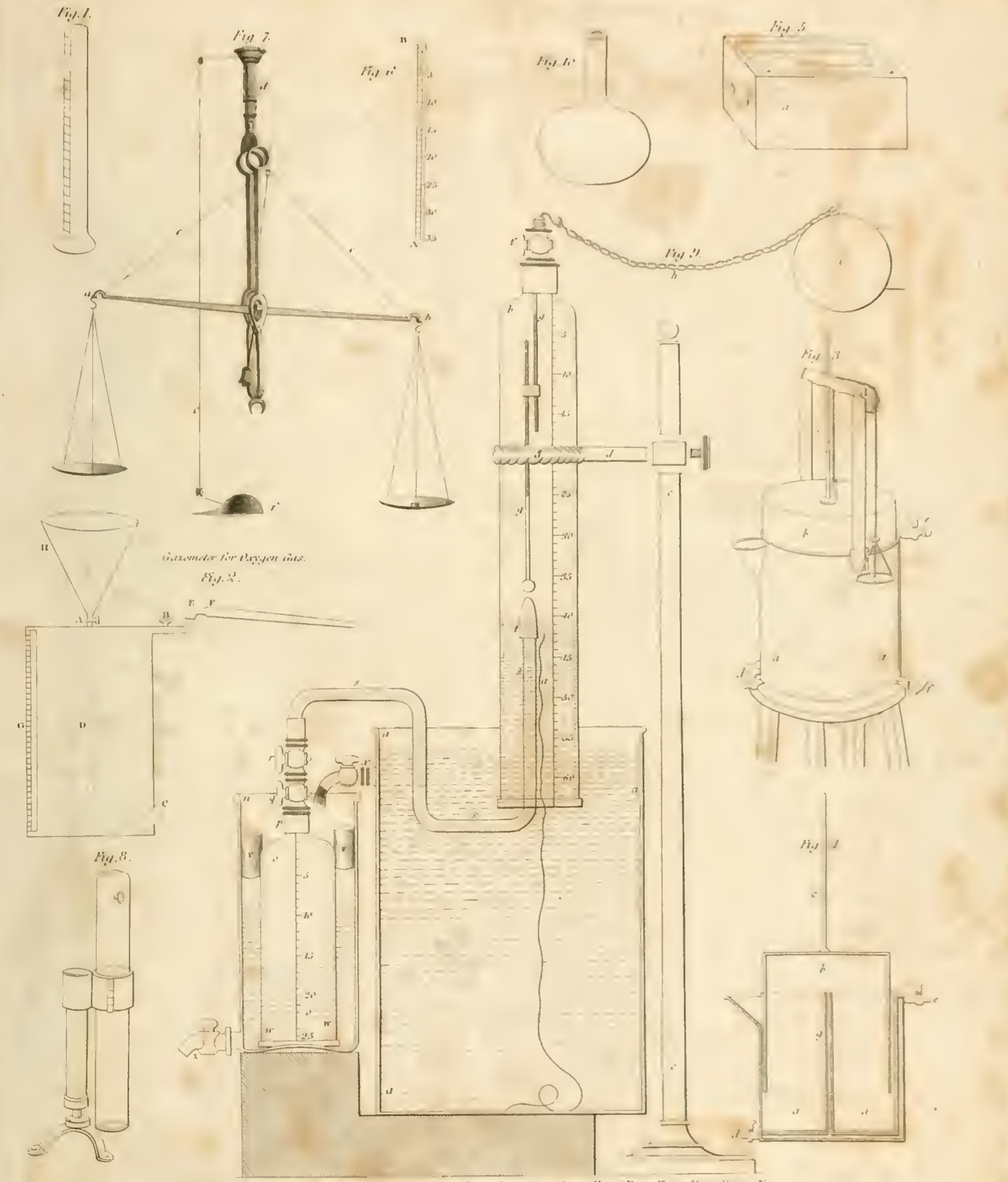
TAMULIAN OR MALABARIC *NUMERALS.*

௧	1	௮	8	௨௰	20
௨	2	௯	9	௩௰	30
௩	3	௰	10	௪௰	40
௪	4	௰௧	11	௱	100
௫	5	௰௨	12	௲	1000
௬	6	௰௩	13	௨௲	2000
௭	7	௰௪	14		

Annan Sc

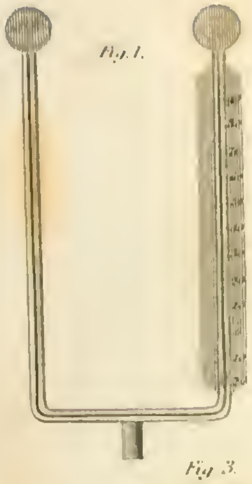
CHEMISTRY.

PLATE CXLII.



CHEMISTRY.

PLATE CXLII.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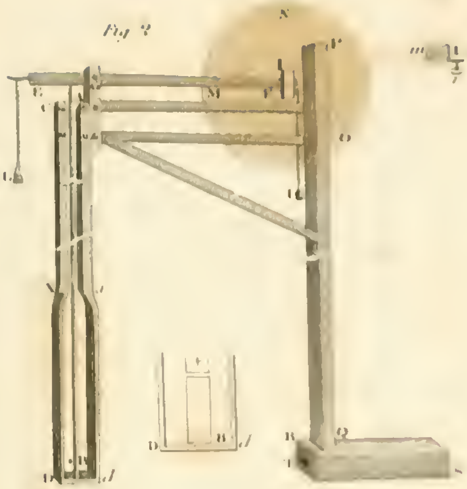
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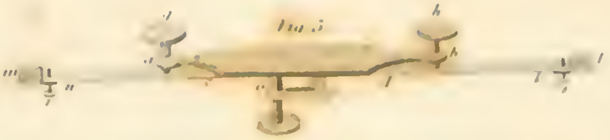
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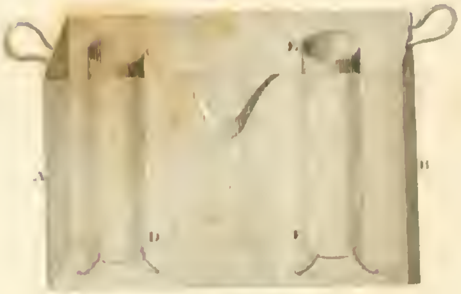
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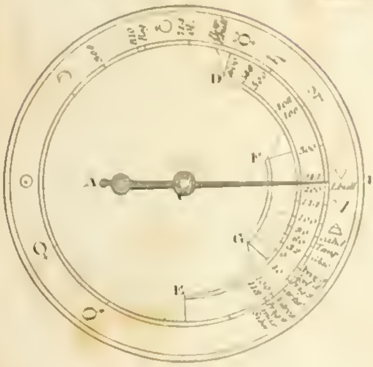
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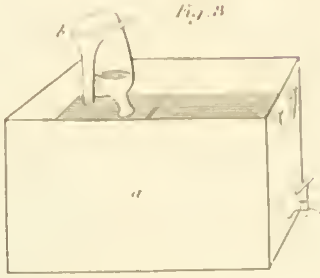
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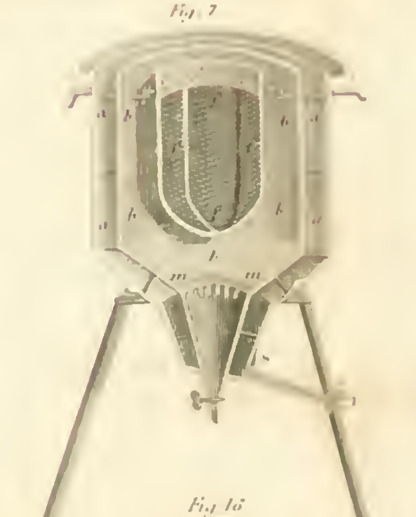
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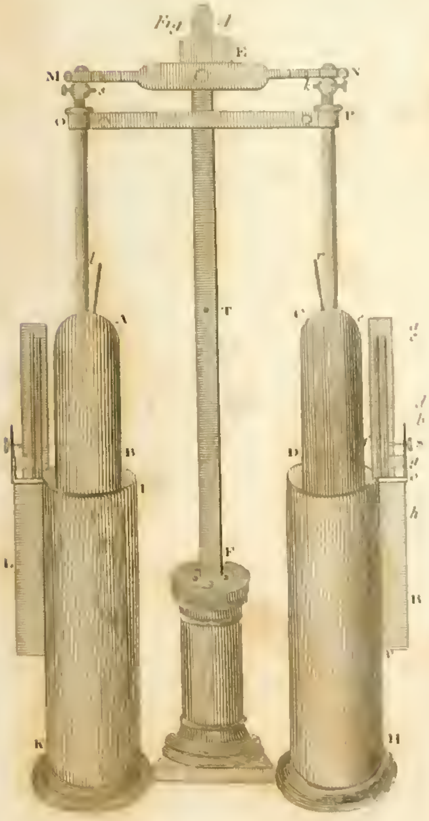
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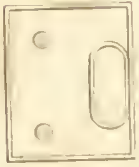
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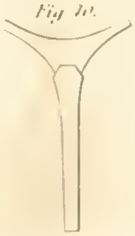
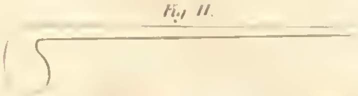


Fig. 10.

Fig. 16.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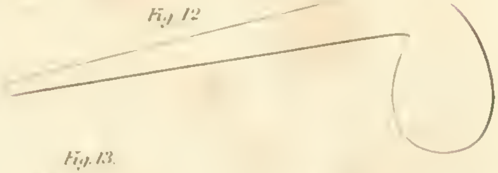
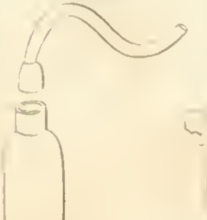


Fig. 12.

Fig. 17.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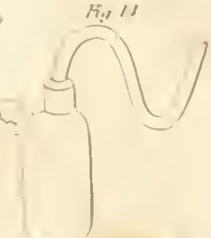
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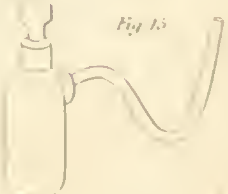
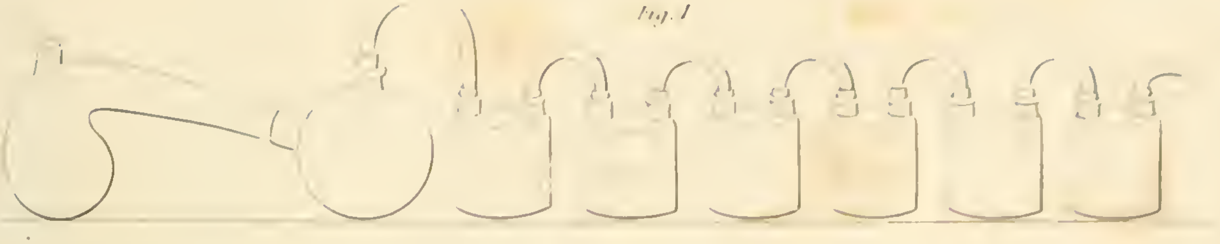


Fig. 15.

CAMPHOR.

Fig. 1



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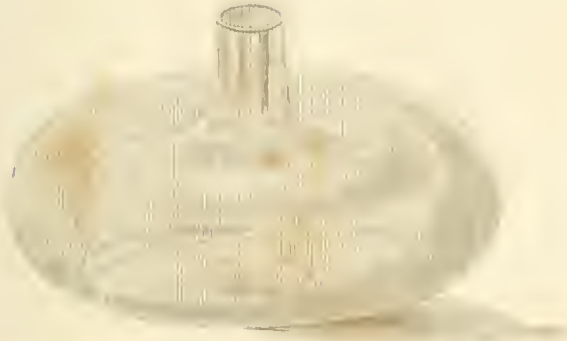

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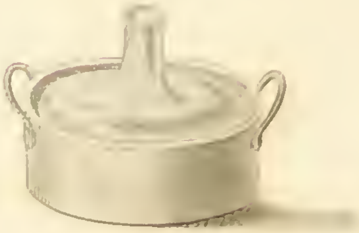

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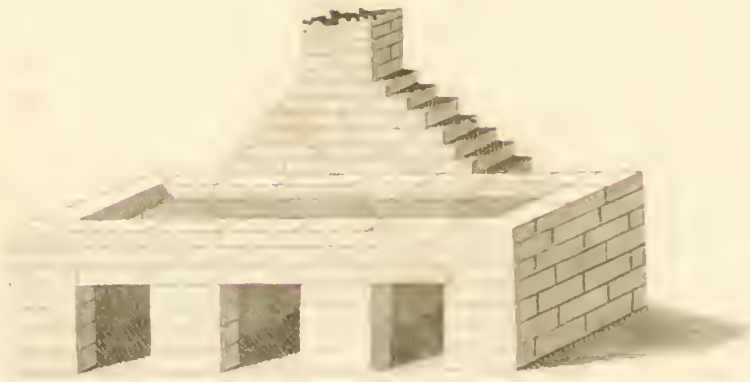

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